The Adaptation and Norming of Selected Psychometric Tests for 12- to 15-year-old Urbanized Western Cape Adolescents.

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DECLARATION

By submitting this dissertation electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the authorship owner thereof (unless to the extent explicitly otherwise stated) and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

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Abstract

The practice of psychometric testing of cognitive functioning in South Africa is hampered by the paucity of normative data that adequately characterize our ethnically, linguistically, socioeconomically, and educationally diverse population. The general aim of this study was to ascertain whether cognitive tests developed in settings outside of the Western Cape urbanized area have valid application for clinical and research purposes in that area. Strategies used to achieve that aim included: 1) translation, adaptation, and subsequent administration of a compendium of tests in a sample of typically developing, coloured and white, 12- to 15-year-old, Afrikaans- and English-speaking adolescents; 2) evaluation of the relative impact of sociodemographic factors (age, sex, language, quality of education, and race) on test performance and the consequent derivation of appropriately stratified normative data; and 3) evaluation of the cross-cultural utility of the normative data by comparing data collected from the study sample to norms derived from other populations. Results indicated that sex and language of testing impacted minimally on cognitive functioning. In contrast, the pervasive and deleterious impact of disadvantaged quality of education on cognitive performance within typically developing adolescents was clearly demonstrated. For participants with advantaged quality of education, coloured race was associated with lower performance on measures of intelligence, semantic fluency, and one measure of attention. Furthermore, the results provided evidence of age-related increments in cognitive performance, particularly after the age of 12. For cognitive measures that were significantly affected by language, race, and quality of education, trends of a downward continuum of performance were demonstrated, from highest to lowest, as follows: 1) English-white-advantaged; 2) Afrikaans-white-advantaged; 3) English-coloured-advantaged; 4) English-coloured-disadvantaged; 5) Afrikaans-coloured-advantaged; and 6) Afrikaans-coloured-disadvantaged. Cross-cultural comparisons of norms showed that for some tests, norms derived from other populations were suitable for use in the study sample. For other tests, however, results showed that for certain subgroups, it was essential to use the stratified norms derived from the study in order to prevent misdiagnoses.

Opsomming

Die psigometriese toetsing van kognitiewe funksionering word in Suid-Afrika gekniehalter deur ŉ gebrek aan normatiewe data wat ons etnies, taalkundig, sosio-ekonomies en opvoedkundig diverse bevolking genoegsaam tipeer. Die algemene doel van hierdie studie was om vas te stel of kognitiewe toetse wat in omgewings buite die Wes-Kaapse stedelike gebied ontwikkel is, ook vir kliniese en navorsingsdoeleindes binne hierdie stedelike gebied aangewend kan word. Hiervoor is onder meer die volgende strategieë gevolg: 1) ŉ kompendium toetse is vertaal, aangepas en vervolgens afgeneem onder ’n toetsgroep tipies ontwikkelende, bruin en wit, 12- tot 15-jarige, Afrikaans- en Engelssprekende adolessente; 2) die relatiewe impak van sosiodemografiese faktore (ouderdom, geslag, taal, opvoedingsgehalte en ras) op toetsprestasie, en die gevolglike verkryging van toepaslik gestratifiseerde normatiewe data, is beoordeel en 3) die kruiskulturele nut van die normatiewe data is beoordeel deur die data wat van die toetsgroep in hierdie studie verkry is, te vergelyk met norme wat van ander populasies bekom is. Die resultate toon dat geslag en die taal waarin die toets afgeneem word ŉ minimale uitwerking op kognitiewe funksionering het. Daarenteen is duidelik bewys dat swakker gehalte opvoeding ’n verreikende en skadelike uitwerking op die kognitiewe funksionering van tipies ontwikkelende adolessente het. By deelnemers met beter gehalte opvoeding blyk daar ŉ verband te wees tussen die bruin rassegroep en laer prestasie wat betref maatstawwe van intelligensie en semantiese vaardigheid, asook een maatstaf van konsentrasie. Voorts lewer die resultate bewys van ouderdomsverwante toenames in kognitiewe prestasie, veral ná die ouderdom van 12. Wat betref kognitiewe maatstawwe wat beduidend deur taal, ras en opvoedingsgehalte beïnvloed is, is ŉ afwaartse prestasiekontinuum opgemerk wat van hoog na laag soos volg daar uitsien: 1) Engels-wit-bevoordeel, 2) Afrikaans-wit-bevoordeel, 3) Engels-bruin-bevoordeel, 4) Engels-bruin-benadeel, 5) Afrikaans-bruin-bevoordeel en 6) Afrikaans-bruin-benadeel. Kruiskulturele normvergelykings toon dat, wat sommige toetse betref, die norme wat van ander populasies bekom is ook geskik was vir gebruik onder die toetsgroep in hierdie studie. Wat ander toetse betref, het die resultate egter getoon dat dit by bepaalde subgroepe noodsaaklik is om die gestratifiseerde norme wat uit die betrokke studie afgelei is te gebruik ten einde verkeerde diagnoses te voorkom.

Acronyms and Abbreviations

ADHD	Attention-deficit/hyperactivity disorder
ANCOVAs	Analyses of covariance
ANOVAs	Analyses of variance
AVLT	Auditory Verbal Learning Test
CCTT	Children's Color Trails Tests
CDT	Clock-Drawing Task
CED	Cape Education Department
CMS	Children's Memory Scales
COWA(T)	Controlled Oral Word Association (Test)
CTMT	Children's Trail Making Test
CTT	Color Trails Test
DET	Department of Education and Training
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders – 4th edition
EEG	Electro-encephalography
EF	Executive Functioning
EHI	Edinburgh Handedness Test
FSIQ	Full Scale Intelligence Quotient
GPT	Grooved Pegboard Test
HOD	House of Delegates
HOR	House of Representatives
HSRC	Human Sciences Research Council
IQ	Intelligence Quotient
K-SADS-PL	Schedule for Affective Disorders and Schizophrenia for School Aged Children (6-18 years) Lifetime Version
M.I.N.I. Kid	Mini International Neuropsychiatric Interview for Children and Adolescents
MAVLT	Maj's Auditory Verbal Learning Test (WHO/UCLA version)
MRI	Magnetic Resonance Imaging
PCA	Principal component analysis
PIQ	Performance Intelligence Quotient
RAPM	Raven's Advanced Progressive Matrices
RAVLT	Rey's Auditory Verbal Learning Test
RCPM	Raven's Coloured Progressive Matrices
ROCFT	Rey-Osterrieth Complex Figure Test
RSPM	Raven's Standard Progressive Matrices
SA-WAIS	South African Wechsler Adult Intelligence Scale (SA-WAIS)
SCWT	Stroop Color-Word Test
SD	Standard Deviation
SES	Socioeconomic status
SPSS	Statistical Package for the Social Sciences (SPSS) version 17
SSAIS-R	Senior South African Individual Scale Revised version
TBI	Traumatic Brain Injury
TMT	Trail Making Tests
ToL	Tower of London
UCLA	University of California, Los Angeles
UK	United Kingdom
USA	United States of America
VIQ	Verbal Intelligence Quotient
WAIS III	Wechsler Adult Intelligence Scale - 3rd edition
WASI	Wechsler Abbreviated Scale of Intelligence

WCE	Western Cape Education
WHO	World Health Organization
WISC-III	Wechsler Intelligence Scale for Children - 3rd edition
WISC-IV	Wechsler Intelligence Scale for Children - 4th UK edition
WISC-R	Wechsler Intelligence Scale for Children - Revised edition
WMS	Wechsler Memory Scales
ESE	Hedges' *g* effect size estimate

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Prologue

The psychometric assessment of cognitive functioning constitutes an integral component of psychiatric and psychological evaluations. Cognitive tests, and the results thereof, are used for multiple purposes within a wide range of professional disciplines. The interpretation of cognitive test data is highly contingent on the suitability of the test for the individual being assessed, and on an understanding of the individual's cognitive functioning in relation to a comparable population. Both the utility of the cognitive tests and the veracity of the interpretation of test data are severely compromised in the absence of tests and related normative data (norms) that are appropriate for the sociodemographic profile of the individual being tested.

Cognitive tests designed and developed outside of South Africa are frequently used to test South Africans. The extent to which this practice is appropriate or useful is contingent on a variety of factors, two of which are central to this dissertation: 1) the translation and adaptation of cognitive tests for local use; and 2) the collection of appropriately stratified norms (i.e., those that provide the best goodness-of-fit between the individual or group being tested and the sociodemographic characteristics of the sample from which the norms were derived).

The relative paucity of adapted and formally translated test material and associated norms appropriate for the diverse South African population has been well articulated. The contribution of this dissertation is that it provides 1) methodological guidelines regarding the process of assessing, adapting, translating, and norming cognitive tests, and 2) stratified norms for a selection of cognitive tests, for a narrowly defined population, viz., coloured and white, Afrikaans- and English-speaking adolescents (aged 12-15), from a range of socioeconomic backgrounds, who have had access to differing qualities of education, and who are resident in the greater Cape Town urban metropolitan region.

Cognitive tests and corresponding data are used by a range of practitioners with divergent levels of interest in, understanding of, and exposure to the past and current issues, procedures, protocols, and contextual complexities involved in psychometric testing in South Africa. The potential audience of this dissertation ranges from students to highly experienced professionals, both local and international, within the fields of medicine (e.g., neurosurgeons, neurologists, psychiatrists, paediatricians, and nurses), allied professions (e.g., speech therapists, occupational therapists, physiotherapists, and social workers), psychology (industrial, clinical, counseling, and educational), education, and the law.

The dissertation is structured in four sections, similar, but not identical to the structure of a single journal article, viz., Introduction, Methods, combined Results and Discussion, and Evaluation and Recommendations. In the Introduction, I critically examine the complexities of psychometric test selection. I describe how neuropsychology provides a useful conceptual framework to guide decisions regarding which aspects of cognitive functioning to measure (i.e., neuropsychological domains), how to measure them (i.e., which cognitive tests to use), and how to interpret data meaningfully within the norm-referenced approach to psychometric measurement (i.e., which norms to use). I describe the rationale for testing particular populations; why testing adolescents is valuable and informative; and how non-neurological factors such as procedural rigour and sociodemographic characteristics affect the administration and interpretation of cognitive tests. I provide explanations of why norms are necessary and how they are established. I also justify the use of tests which were not specifically designed for the local population; and, based on the experiences of previous local and international researchers, why the collection of local norms is essential. Finally, I delineate some of the difficulties experienced and lessons learned from other South African normative studies.

The Methods section contains descriptions of the research design, participants, setting, screening and testing processes, and detailed descriptions of the materials and methods used. Because testing protocols vary widely for most of the tests were used in the current study, I specify exactly which administration and scoring procedures are used. Where detailed administration and scoring instructions are provided in the test manuals, or in seminal neuropsychological texts (viz., Lezak, Howieson, & Loring, 2004; Mitrushina, Boone, Razani, & D'Elia, 2005; Strauss, Sherman, & Spreen, 2006), I direct the reader to the primary source. I do, however, describe procedures that have not been published, or that deviate from standard published protocols, in detail. I refer to the utility of the tests within the parameters of the study sample. I restrict descriptions of the psychometric properties of the tests to test-retest reliability and construct validity, which are the most crucial types of reliability and validity to consider when selecting cognitive tests. I also describe the methods and processes involved in adapting particular tests for local use in the methods section.

In the combined Results and Discussion section, I present and discuss the results, descriptive norm tables, and cross-cultural comparisons of norms separately for each cognitive test. This section provides detailed evaluations of the relative influences of the sociodemographic variables (i.e., age, sex, language, race, and quality of education) on cognitive test performance, and provides guidelines with regards to the appropriate use of normative data. I also provide an overview of the effects of the sociodemographic variables on composite cognitive domains, and present two case studies illustrating some of the interpretive problems associated with using inappropriate norms.

In the final Evaluation and Recommendations section, I discuss the strengths and limitations of the study and make recommendations for further studies relative to these aspects. The dissertation ends with a final overview of issues relative to the interpretation of psychometric test results and the selection and use of normative data.

A few explanations regarding terminology used for the dissertation are necessary. Although neither this study, nor this dissertation would have been possible without the involvement of a team of colleagues and expert consultants, whose contributions are gratefully acknowledged, I refer to myself in the first person singular to acknowledge my personal responsibility for the content of the dissertation. I refer to the descriptive terminology used in the South African census publications (Statistics South Africa, 2001, 2007) to refer to race, without any political agenda. For the purpose of brevity, I use acronyms (which are described in the methods section) to name the cognitive tests and subtests in the text.

1. Introduction

The paucity of South African norms for psychometric tests of cognitive functioning has been widely acknowledged (Claassen, 1998; Foxcroft, Paterson, Le Roux, & Herbst, 2004; Huysamen, 2002; Nell, 2000; Owen, 1996). In response to this shortage, South African norms for some cognitive tests have been collected and published on a variety of cognitive tests, for example: intelligence scales (e.g., Claassen, Krynauw, Holtzhausen, & Mathe, 2001; Grieve & van Eeden, 2010a; Shuttleworth-Edwards, Kemp et al., 2004; Shuttleworth-Edwards, Van der Merwe, van Tonder, & Radloff, in press); single cognitive tests (e.g., Boon & Steel, 2005; Knoetze, Bass, & Steele, 2005); excerpts from a particular test battery (e.g., Jansen & Greenop, 2008); small collections of eclectic tests (Cavé & Grieve, 2009; Grieve & Viljoen, 2000); or comprehensive batteries of eclectic tests (e.g., Shuttleworth-Jordan, 1996; Skuy, Schutte, Fridjhon, & O'Carroll, 2001). Despite the collective contribution of these studies, there is still a profound imbalance between supply and demand for norms for the prolific volume of available tests used to measure cognitive functioning in our heterogeneous society.

1.1. Challenges involved in the process of norming cognitive tests

One of the challenges confronting normative research is maintaining a balance between adequate sample size and effective control of extraneous variables, in the context of pragmatic constraints. The generalizability of norms to the broader population, and the consequent clinical utility of the norms, is indubitably affected by small sample sizes, and by inadequate control of influential sociodemographic variables, even in studies with very large sample sizes (Mitrushina et al., 2005; Strauss et al., 2006).

1.1.1. Sample size and stratification of norms

In the history of South African norming studies, the extremes of this dilemma have been exemplified in studies published by Shuttleworth-Edwards et al., and Claassen et al. For example, Shuttleworth-Edwards (in press) justifies small group sizes (n = 9-12) on the grounds that Mitrushina et al. (2005) consider well-stratified norms on small samples to be superior to inadequately stratified norms on large samples, despite the fact that Mitrushina et al. reject studies with samples less than 50 from their meta-analyses. Nevertheless, one of the effective strategies adopted by Shuttleworth-Edwards and colleagues to compensate for small samples is to accumulate and cross-validate data derived from a collection of separate studies and to then present the collective data with larger overall sample sizes (Shuttleworth-Edwards, Kemp et al., 2004; Shuttleworth-Edwards et al., in press; Shuttleworth-Jordan, 1996). Importantly, because the studies by Shuttleworth-Edwards and colleagues tend to be designed with pre-planned sampling matrices, are well balanced between comparative groups, and are carefully stratified by relevant sociodemographic variables (e.g., race, test language, level and quality of education), the resultant normative tables provide clinically useful data that effectively characterize the cognitive functioning of particular subgroups in the Eastern Cape province. In short, it would be highly misleading to negatively evaluate the contribution of Shuttleworth-Edwards and colleagues' work solely on the grounds of sample size.

On the other hand, the South African standardization of the Wechsler Adult Intelligence Scale - 3rd edition (WAIS-III), published by Claassen and colleagues (2001) boasts a nationally representative sample size (*n* = 900), which is 18 times greater than Mitrushina et al.'s recommendation, and more than double the size of Foxcroft's more stringent recommendation of 400 (C. D. Foxcroft, 2005) for the development of new test material in South Africa. Despite this achievement, the Claassen et al. study has been widely criticized for numerous reasons (which are elaborated in Section 1.9.2.1.), not least of which is the failure to stratify the norms by race, resulting in data sets that do not adequately characterize any particular sector of the adult population in a clinically meaningful way (Foxcroft & Aston, 2006; Shuttleworth-Edwards, Kemp et al., 2004; C. van Ommen, 2005b). Insufficiently stratified norms that do not adequately represent the diversity inherent in heterogeneous samples are misleading and exacerbate the odds of faulty decision making (Nell, 2000; Shuttleworth-Jordan, 1996, 1997)

1.1.2. Feasibility of norming research

Ideally, normative studies should have adequate sample sizes and control of extraneous variables. In reality, the extent to which these goals are attainable is heavily dependent on pragmatic factors such as time constraints and the availability of appropriate funding, material resources, qualified testers, and experienced researchers dedicated to normative work. Large-scale normative studies tend to be logistically difficult, time-consuming, and extremely expensive (C. D. Foxcroft & Roodt, 2005; Nell, 2000; Shuttleworth-Jordan, 1996). Being descriptive rather than experimental, they tend to be less successful than their hypothesis-testing competitors in attracting offers of adequate funding (Mitrushina et al., 2005), particularly in developing countries (Kanjee, 2005). The fact that approximately two-thirds of human science research projects in South Africa are externally funded may also contribute to the ongoing paucity of local normative studies (Razzouk et al., 2010).

1.2. Solutions to norming challenges

Undaunted by the inherent complexities, and sometimes in the absence of adequate funding, numerous researchers have followed Shuttleworth-Jordan's (1996) challenge not to be nihilistic regarding the paucity of valid norms, and have taken a proactive stance by conducting pockets of normative research in South Africa.

Research projects conducted by postgraduate psychology students and interns have also resulted in collections of data with restricted sample sizes, but with pre-selected and well-matched groups and well-stratified norms. Some of these data have been published in peer-reviewed journals (e.g., Cavé & Grieve, 2009), or book chapters (e.g., Shuttleworth-Edwards et al., in press), or presented orally with accompanying handouts at professional conferences (e.g., Ferrett, Dowling, Conradie, & Thomas, 2010), making the norms accessible to the professional community.

Other research has dealt with logistical constraints by focusing on highly homogenous populations. For example, Jinabhai et al. (2004) tested circumscribed aspects of cognitive functioning (4 tests) on a large group (n = 806) of rural, first language Zulu-speaking, ethnic Zulu children, between 8 and 11 years of age, but who had all attained the same level of education (grade 3) within a disadvantaged educational system. The need to stratify the norms for demographic variables other than age and sex was obviated, resulting in large cell sizes (n = 83 for the smallest subgroup) and data that can be regarded as highly representative of the defined population.

An alternative approach to collecting norms is to utilize healthy control subjects who are matched to subjects in clinical studies (Strauss et al., 2006). The benefits of this approach, which is the one adopted in my dissertation, are that normative sub-studies are feasible within the material and professional infrastructures of externally funded mother studies, providing data that are useful for local purposes and for international audiences. The limitations of normative research embedded in non-normative studies are that certain methodological and sampling constraints are imposed on the research. In the case of the current study, the age range and language of the participants were pre-determined (i.e., restricted to 12- to 15-year-old, Afrikaans- and English-speakers), and the composition of the sample was primarily determined by criteria that matched adolescents with alcohol-use disorders to healthy controls, according to age, sex, language, quality of education and socioeconomic status. Despite the fact that the sampling parameters were constrained, the study provided a useful opportunity to characterize the cognitive functioning of a subsector of the population for whom norms are exceedingly scarce (i.e., coloured adolescents); to examine the effects of sociodemographic influences (e.g., race, quality of education, and language) on cognitive functioning during a particularly interesting, developmentally active, and under-reported developmental phase.

The selection of cognitive tests was constrained within a maximum time limit (approximately 3 hours). The selected tests needed to assess cognitive domains known to affect populations with alcohol-use disorders. Furthermore, the tests also needed to provide assessments within all the primary domains of cognitive functioning. Both the suggested time restrictions and the use of a compendium of tests that measure a general-purpose range of cognitive domains are considered to be basic prerequisites of clinical practice (e.g., V. Anderson, Northam, & Wrennal, 2001).

1.3. Cognitive testing of adolescents

Cognitive assessments are used in a variety of clinical, research, and legal environments. The aim of such assessments is to determine the individual's relative cognitive strengths and weaknesses (Hemp, 2008; Mitrushina et al., 2005). This determination is clinically useful for the following purposes for all age groups: identifying and confirming diagnoses; providing an understanding of the functional impact of neurological conditions; defining baseline levels of functioning for longitudinal comparisons; monitoring and predicting treatment outcomes; and informing decision making within forensic and litigation settings; and particularly for children and adolescents: identifying educational and learning difficulties; identifying potential in individuals who may benefit from further education and training; and making vocational recommendations (Darby & Walsh, 2005; Foxcroft, 1997, 2004; Hemp, 2008; Mitrushina et al., 2005; Strauss et al., 2006).

Cognitive assessments in adolescents are particularly useful to guide decision-making with regards to which secondary schools to attend, subject choices for the senior secondary educational phase, and planning for further education and training decisions related to careers. These types of assessments are typically conducted by educational and counseling psychologists (C. D. Foxcroft & Roodt, 2005).

Adolescence is a time of social experimentation, loosening boundaries from familial frameworks, increased peer influence, and increased risk-taking behaviour (Ernst & Fudge, 2009; Wahlstrom, White, & Luciana, 2010). Consequently, it is a period with heightened vulnerability for the development of substance-use and eating disorders, sexually transmitted diseases, and HIV infection (Clark, Jones, Wood, & Cornelius, 2006; Jinabhai et al., 2004; Squeglia, Spadoni, Infante, Myers, & Tapert, 2009). Cognitive assessments are useful to evaluate the effects of, and to monitor treatment outcomes of, such and other emerging psychiatric conditions (e.g., early-onset schizophrenia), as well as conditions that may have emerged during childhood , for example, attention-deficit/hyperactivity disorder (ADHD; V. Anderson, Northam et al., 2001; Giedd, Keshavan, & Paus, 2008).

There are high levels of interpersonal violence and motor vehicle accidents in South Africa, resulting in a high incidence of traumatic brain injury (K. Levin, 2004). Furthermore, repetitive concussive injuries in players of contact sports (e.g., rugby) have been associated with enhanced cognitive vulnerability, which is translated into difficulties in concentrating, learning, and processing information at speed. Consequently, cognitive assessments of adolescents who have sustained such injuries is essential to monitor the impact of the injuries and to guide return-to-play and termination decisions (Shuttleworth-Edwards, Smith, & Radloff, 2008; Shuttleworth-Edwards & Whitefield, 2007). Cognitive assessments in the abovementioned contexts are typically conducted by clinical psychologists or neuropsychologists, usually under the conceptual framework of neuropsychology, which is informed by a substantial body of literature regarding the relationship between the brain and the cognitive-behavioural expression of brain function and dysfunction (Lezak et al., 2004).

There is a difference between cognitive testing and assessment. Ideally, testing is one component of an integrated assessment process, involving more than merely the reporting of psychometric scores (Foxcroft, 1997; Hemp, 2008; Lezak et al., 2004; Nell, 2000). The efficacy of assessment is dependent on the quality of each of its components. In this dissertation, I focus exclusively on the quality of the psychometric element of cognitive assessment. In all the abovementioned situations, meaningful cognitive testing is highly contingent on 1) the selection of tests appropriate for the purpose of the assessment and for the sociodemographic profile of the individual being tested; 2) the quality of the measuring instrument; and 3) the extent to which non-neurological factors (which impact on the test results and interpretation thereof) are controlled for. Before elaborating on these issues, however, I introduce some concepts that are integral to framing our understanding of typical and atypical adolescent cognitive functioning. It is important to have a good indication of the parameters of normal functioning in order to recognize abnormal functioning. Clinicians in South Africa are often required to decide whether an individual’s cognitive test results are indicative of impairment, without having access to adequate information regarding the parameters of normal cognitive functioning in relation to demographically comparative populations (Foxcroft, Paterson, le Roux, & Herbst, 2004; Grieve, 2005; Knoetze et al., 2005; Shuttleworth-Jordan, 1996).

1.3.1. Neuropsychology and neuroimaging

The neuropsychological constructs of functional domains, as described in three seminal neuropsychological texts (Lezak et al., 2004; Mitrushina et al., 2005; Strauss et al., 2006) provide a useful framework for describing a broad range of cognitive functioning. These texts also provide substantial literature associated with the tests used to measure cognitive functioning and the associated norms used to interpret the test results.

The functional domains described in this dissertation include intelligence, attention, processing speed, fine motor coordination, visuospatial abilities, memory, and executive functioning. The extent to which functional domains are affected by a neurological condition can be assessed in numerous ways, for example, psychometric measurement, intuition/clinical judgment, or a combination of the latter two approaches. Because this dissertation focuses on gathering normative data, I use the psychometric paradigm, and use cognitive tests to measure the functional domains.

Neuropsychology has advanced considerably in recent decades by the development of non-invasive *in vivo* imaging techniques, for example, positron emission tomography, structural and functional magnetic resonance imaging, and electroencephalography (V. Anderson, Northam et al., 2001; Luna, 2009; Yurgelun-Todd, 2007). These techniques have supplemented information yielded from other techniques (Gogtay et al., 2004; Luna, 2009). The triangulation of different types of data has enhanced our understanding of cognition (Ernst & Fudge, 2009; C. van Ommen, 2010).

Acknowledgment of the differences between the brains of children and adults has resulted in age-related neuropsychological subspecialties, namely paediatric and adult neuropsychology. The paediatric neuropsychologist assesses cognitive functioning within the dynamic context of the rapidly developing brain of the child. Adult neuropsychologists work within the parameters of a mature brain that is characterized by relatively stable functioning over many decades until old age (V. Anderson, Northam et al., 2001; Dennis, 2009; Dennis et al., 1991). Although there is no specifically designated subspecialty for adolescent neuropsychology, there is much evidence to suggest that adolescent brain functioning differs from both children and adults in significant ways. By adolescence, the developmental trajectory of functioning in most domains has reached a relatively stable plateau. One notable exception to this pattern is that executive functioning continues to develop during and beyond adolescence (Giedd et al., 2008; Gogtay et al., 2004; Luna, 2009; Shaw et al., 2006; Sowell, Thompson, & Toga, 2004; Yurgelun-Todd, 2007).

1.4. Neuropsychological and biological factors influencing adolescent cognition

Adolescence is a term typically used to describe the age range from 12 to 17 years. The age range of the current study sample (i.e., 12 to 15 years) encompasses the early to middle phases of adolescence (Luna, 2009). Although there is some variability, the onset of adolescence is typically marked by pubertal hormonal changes that mark the onset of a multidimensional (physiological, neurological, emotional, social, cognitive, and behavioural) maturation process that enables the adolescent to prepare for adult life (Ernst & Fudge, 2009; Luna, 2009; Yurgelun-Todd, 2007).

Luna (2009) characterizes the adolescent transition process as a shift in balance from the predominantly *exogenous* behaviour of childhood (i.e., behaviour that is reflexive, automatic, and strongly affected by external stimuli) to more *endogenous* behaviour (i.e., that which is voluntary, planned, and more internally motivated). Endogenous behaviour is contingent on effective executive functioning, which involves the ability to exercise cognitive control. Cognitive control is achieved through a number of interrelated processes that include holding an end goal in mind for long enough to plan and execute a task, while voluntarily inhibiting inappropriate responses, avoiding distraction, and monitoring both the process and the endpoint (Luna, 2009). In neuropsychological terms, executive functioning thus incorporates the use of working memory, planning and organization, response inhibition, and self-monitoring (Luna, 2009).

The efficacy of executive functioning, in turn, is influenced by the limitations of the immature brain, in which the capacity for cognitive control has not yet been stabilized. There seems to be a neurological and chemical basis for some of the inconsistencies evident in adolescent behavioural regulation, which is often characterized by emotional lability, impulsivity, increased risk-taking behaviour, limited appreciation for long-term consequences, and errors in judgment (Blakemore & Choudhury, 2006; Ernst & Fudge, 2009; Giedd, 2004; Luna, 2009; Wahlstrom, Collins, White, & Luciana, 2010; Yurgelun-Todd, 2007). While adolescent brain maturation leads to increasingly efficient goal-directed behaviour, the process can be staggered and sporadic and is not simply linear or necessarily synchronous across domains. Typically, the "intense affective expression, impulsive responses and gains in intellectual abilities seem not to be integrated into life choices" (Yurgelun-Todd, 2007, p. 251).

Despite having to manage the demands of personal maturation in the context of expanding social influences and expectations, adolescence represents a window of opportunity to eventually successfully navigate the transition from dependence on caregivers to self-sufficiency (Giedd et al., 2008). In contrast, the adolescent transitional period also represents a window of vulnerability, during which "moving parts get broken" (Giedd et al., 2008, p.9). For example, damage (caused by injury, disease, toxic exposure, etc.) to immature brain regions may result in arrested development of executive control, and of other neuropsychological domains that are associated with executive functioning. Such brain insults compromise the actualization of the individual's full potential, including the ability to compensate for other deficits (V. Anderson, Northam et al., 2001; Lezak et al., 2004; Luna, 2009). Furthermore, adolescents are vulnerable to developing cognitive, affective, addictive and behavioural disorders, for example, anxiety, bipolar, depressive, psychotic, and eating disorders, developmental dyslexia, Tourette's syndrome, substance-related disorders, conduct- and oppositional-defiant disorders (Giedd et al., 2008; Kessler et al., 2005; Marsh, Gerber, & Peterson, 2008).

The focus of this dissertation is on the cognitive functioning of the typically developing adolescent. I do not, therefore, provide detailed explanations of aspects beyond the specified scope. Topics such as neuroanatomy, neurophysiology, imaging techniques, neuropathological conditions, and neuroanatomical correlates of neuropsychological functions, are explained in the core literature (e.g., Ernst & Fudge, 2009; Giedd, 2004; Gogtay et al., 2004; Lezak et al., 2004; Luna, 2009; Sowell et al., 2004; Yurgelun-Todd, 2007). I do, however, attempt to provide a brief summary of some of the findings that are pertinent to understanding adolescent cognitive functioning in the context of the typically developing adolescent brain, in order to facilitate the recognition of pathological functioning.

1.4.1. Neuroanatomy of the typically developing adolescent brain

The brain reaches 95% of its adult weight and size between the ages of 5 and 11 years, so the overall structure of the brains of adolescents and adults is very similar (Dennis, 2009; Giedd, 2004). There is, however, continued developmental change in localized regions of the cerebral cortex during adolescence, as the brain undergoes a remodeling process (Sowell et al., 2004;

Yurgelun-Todd, 2007). In 12- to 16-year-olds, this maturation process occurs predominantly in dorsal, medial and lateral frontal brain regions (Sowell, Holmes, Jernigan, & Toga, 1999). In fact, the dorsolateral prefrontal cortex does not reach its full volume until the early 20's (Giedd, 2004). The maturation of the prefrontal cortex facilitates improvements in abstract reasoning, attentional shifting, response inhibition, and processing speed (Yurgelun-Todd, 2007).

The process of brain maturation in children and adolescents differs qualitatively. Childhood development involves the acquisition of new brain functions and associated skills (for example, sensory and motor skills), whereas during adolescence, pre-existing skills are refined and eventually reach adult levels of efficiency and sophistication (Luna, 2009; Sowell, Thompson, & Toga, 2004). Although brain structure in adolescents and adults is similar, functional pathways and integrative functions differ (Yurgelun-Todd, 2007). For example, when performing the same executive tasks, adolescents and adults typically enlist different brain regions (Meyer-Lindenberg, 1996). During adolescence, recruitment is primarily in the prefrontal cortex, whereas in adults, activation is distributed more evenly across the cortex. This allows the prefrontal recruitment region to be supported by other brain areas, while maintaining its regulatory role (Luna, 2009; Yurgelun-Todd, 2007). Adolescent brain remodeling is widely considered to be facilitated by progressive maturation and pruning processes in prefrontal white and grey matter, respectively.

Brain imaging studies show that while performing the same task, more diffuse brain activation occurs in pre-adolescence, demonstrating the use of more cognitive resources, compared to post-adolescence, when activation tends to be more localized, demonstrating the use of fewer resources (V. Anderson, Northam et al., 2001; Giedd, 2004; Giedd et al., 1999). Gogtay et al.'s (2004) longitudinal structural magnetic resonance imaging study of 14 children who were scanned every two years for a decade demonstrated the gray matter trimming process (in time-lapse movie-like format) occurring in a front-to-back, wrap-around sequence (Dennis, 2006). The sequence shows that phylogenetically older brain areas, which fulfill more primitive and basic functions, mature earlier than newer ones, which assist in integrating and interpreting information (Gogtay et al., 2004).

1.4.2. Neural connectivity

There is compelling evidence to suggest that the maturation and remodeling of the adolescent brain, primarily in the prefrontal cortex, is linked to functional changes that may also be associated with changes in neural connectivity and neurotransmission (Giedd et al., 2008).

During adolescence, synaptic pruning occurs in the association areas, not only frontally, but also in other brain regions, for example, the association areas in the temporal lobe; and the basal ganglia (e.g., Gogtay et al., 2004; Sowell et al., 1999). The increasing connectivity of brain areas allows for more efficient integration of information, which in turn facilitates more sophisticated brain functioning, not just within the frontal lobes, but between the frontal lobes and other regions (Luna, 2009). Enhanced interconnectivity within the prefrontal cortex and between it and other subcortical regions is thought to improve the ability to exercise executive control.

Although more mature circuitry has been associated with improved abilities, immaturities in adolescent circuitry have consistently been associated with suboptimal cognitive control. Typically developing adolescents would therefore be expected to display inconsistencies in their abilities to plan and execute goal-directed behaviour and to perform complex computations. While trying to complete tasks, they may experience difficulties remaining impervious to distractions, in inhibiting undesirable responses, and in monitoring errors in performance (Ciesielski, Lesnik, Savoy, Grant, & Ahlfors, 2006; Dosenbach et al., 2006; Fair et al., 2007; Nyffeler et al., 2007; Olesen, Macoveanu, Tegnér, & Klingberg, 2007; Postle et al., 2006; Scherf, Sweeney, & Luna, 2006)

In sum, due to the processes described above, typically developing adolescents demonstrate more stability in non-executive domains than children. In contrast, the efficacy of executive functioning is more variable in adolescents than in children, due to ongoing neuromaturation of the associated neurological structures and processes.

1.5. Domains of cognitive functioning

Neuropsychological texts by Lezak (1983, 1995) and colleagues (Lezak et al., 2004); Strauss and colleagues (Spreen & Strauss, 1998; Strauss et al., 2006) and Mitrushina et al. (2005) have been developed over decades, resulting in multiple editions. These texts provide useful conceptualizations of neuropsychological constructs; describe and evaluate psychometric cognitive testing processes and materials, including norms, and provide guidelines on the clinical utility of the tests. I use the neuropsychological constructs delineated in those core texts to describe the functional modalities useful for psychometric cognitive testing applicable within a wide range of disciplines. The texts by Lezak and colleagues provide detailed information regarding the neuroanatomical correlates of cognitive functioning. The texts by Strauss and colleagues provide detailed pragmatic advice regarding psychometric tests, including where to purchase the tests, how much they cost, administration and scoring information, and normative data. The value of using the texts by Mitrushina and colleagues in the context of normative research is that those volumes focus on supplying and evaluating norms for tests that are commonly used throughout the world, and that they provide valuable meta-analytic norms that synthesize multiple data sets. I have used these three core neuropsychological texts as a conceptual paradigm for the functional cognitive domains and the tests that measure functioning within those domains, and to guide decisions regarding which tests and norms to use for this study.

Lezak (2004) borrows terminology analogous to computer information-processing operations to classify cognitive functions into four major categories. These include: 1) input (i.e., receptive functions, which deal with the selection, acquisition, classification, and integration of new information); 2) storage (i.e., memorization, learning, and retrieval of information); 3) processing (i.e., mental organization of information); and 4) output (i.e., verbal or nonverbal communication or expression of information).

Because cognitive abilities are inferred rather than directly observed from behaviour, the theoretical process of categorizing cognitive functioning into discrete functional components or domains is difficult, inexact, and somewhat artificial (Strauss et al., 2006). Most cognitive tests are multimodal in that they measure more than one domain, or more than one aspect of a domain. There are also many tests that purport to measure the same domains, yet yield conflicting results (Lezak et al., 2004; Llorente, Williams, Satz, & D'Elia, 2003; White, Campbell, Echeverria, Knox, & Janulewicz, 2009). Consequently, there are numerous definitions of cognitive domains, and different opinions about which tests measure these domains most effectively. Although universally identical definitions may be impossible, many commonly accepted definitions have emerged. Where possible, I use such definitions, in accordance with the terminology used by the test developers.

In reality, although cognitive domains are conceptually distinguishable, they tend to operate interdependently (Lezak et al., 2004). Some theorists adopt a gestalt approach to characterize cognitive functioning. They use omnibus, or composite measures, and report findings with a single (or a few) output scores (White, Campbell, Echeverria, Knox, & Janulewicz, 2009). Others reject omnibus measures on the grounds that the reductionist approach results in a loss of data and obscures meaningful information about different aspects of functioning. They thus prefer more discrete, detailed units of measurement, relating to more specific cognitive processes (Strauss et al., 2006). Using the analogy of a school report, a composite aggregate score of 50%, for example, could mean that the individual performs at an average level, but obscures the individual's academic strengths and weaknesses. For example, the 50% aggregate may refer to 48% for mathematics and 52% in first language, but may also refer to 20% for mathematics and 80% for language. Whether or not global or discrete scores are useful depends on the specific purpose of the assessment. If, in the given example, the purpose of the school report is to identify children needing remediation in particular subjects, the discrete scores are more informative than the composite score.

As previously mentioned, in the current study the cognitive tests, and the domains of functioning that they assessed, were constrained by the parameters of the primary study in the following ways: 1) the entire cognitive testing process had to be completed in a time limit of approximately 3 hours (including breaks); 2) the domains known to affect cognition in adolescents with alcohol-use disorders, for example, memory (the learning and retention of new verbal and nonverbal information); attention; visuospatial functioning; and elements of executive functioning, needed to be measured (e.g., Brown & Tapert, 2004; Brown, Tapert, Granholm, & Delis, 2000; Finn & Hall, 2004; Finn et al., 2009; Tapert, Granholm, Leedy, & Brown, 2002); 3) the domains assumed to be unaffected by alcohol use also needed to be measured, so that, for the purposes of the primary study, a profile of impaired and unimpaired cognitive functioning could be created for adolescents with alcohol-use disorders.

The aforementioned constraints were fortuitous in that it was necessary to obtain an overall representation of the key aspects of cognitive functioning. The benefit of adapting and norming such a collection of tests is that they would have wide utility across a broad range of assessment contexts for the defined population of adolescents. Furthermore, this collection of tests could yield useful general and specific information regarding cognitive functioning within a time frame of 3 hours. Due to the fact that I was permitted to select the compendium of tests used in the primary study, I was able to select tests that were appropriate, or potentially appropriate (with modifications) for use within the prescribed population, thereby providing test material and norms with potential for wide applicability in the Western Cape province. The cognitive domains measured by the tests used in this study (i.e., intelligence; attention; processing speed; fine motor coordination; visuospatial abilities; memory; and executive functioning) are described below.

1.5.1. Intelligence

Practitioners who use cognitive tests disagree about whether and how to measure intelligence. Extreme opponents of intelligence testing, such as Lezak et al. (2004), assert that the IQ score is misleading and inherently meaningless and that it has outlived its utility. Other opponents of intelligence testing also argue that intelligence tests do not adequately assist in detecting brain dysfunction (Lezak et al., 2004). On the other hand, extreme proponents assert that because intelligence has been widely demonstrated to affect other cognitive functions, it is not only essential to measure it, but norms should be stratified according to different levels of intelligence (Hiscock, 2007; Mitrushina et al., 2005). They advocate that measuring intelligence is helpful in to estimate premorbid functioning and to predict functional impairment in other domains. Intelligence tests also demonstrate good ecological validity, that is, the capacity to predict future educational and employment outcomes (Hiscock, 2007; Mitrushina et al., 2005; Strauss et al., 2006).

The diverging conceptualizations of intelligence center around whether or not there is a single general intelligence factor or *g* (e.g., Spearman), or multiple factors, (e.g., Thurstone; Carroll-Horn-Cattell; Strauss et al., 2006). The Wechsler intelligence scales have produced evidence supporting the *g* factor in clinical and normal samples (Dana & Dawes, 2007; Watkins, Glutting, & Lei, 2007). These intelligence tests provide composite scores as well as scaled scores for the subtests, allowing the clinician the option of reporting aspects of intelligence in either the global or discrete modalities. The Wechsler scales are widely used (Sattler & Dumont, 2004; Strauss et al., 2006). They have also demonstrated good clinical and ecological predictive validity and consistency. Various forms of reliability estimates often exceed .97, which is rare for neuropsychological tests (Strauss et al., 2006).

The norming of intelligence tests, particularly those designed by Wechsler, and Raven (1998, 2000), has been a popular enterprise in South African research. Unpublished norms, in the form of postgraduate theses (e.g., Andrews, 2008; Fike, 2008; Gaylard, 2006; A. Wong, 2008); and published norms (e.g., Claassen et al., 2001; Grieve & van Eeden, 2010b; Shuttleworth-Edwards, Donnelly, Reid, & Radloff, 2004; Shuttleworth-Edwards, Kemp et al., 2004) are available for the Wechsler Adult Intelligence Scale - 3rd edition (WAIS-III), for the Wechsler Intelligence Scale for Children – Revised edition (WISC-R; Skuy et al., 2001), and for the Wechsler Intelligence Scale for Children – 4th UK edition (WISC-IV; Shuttleworth-Edwards et al., in press).

The Raven's Matrices have been widely normed for black Venda-, Zulu-, and Xhosa-speaking participants, but not for the coloured or white, Afrikaans or English sector of the population. For adults, published norms are available for Raven's Standard Progressive Matrices (RSPM; Grieve & Viljoen, 2000); and unpublished norms on Raven's Advanced Progressive Matrices (RAPM; Israel, 2006). For children, norms are available on Raven's Coloured Progressive Matrices (RCPM), either published (Jinabhai et al., 2004; Knoetze et al., 2005), or unpublished (Kihn, 2005).

Although Raven's Matrices tests are feasible in terms of brevity and capability for group administration, the use of these tests is questionable, due to widely demonstrated cultural bias against black disadvantaged South Africans, for example Venda university students (Grieve & Viljoen, 2000); Zulu (Jinabhai et al., 2004) and Xhosa children (Knoetze et al., 2005). For clinical and research purposes, there is a paucity of general measures of cognitive ability that are both brief and culture-fair (Ryan et al., 2003; Strauss et al., 2006).

1.5.2. Attention

Attention can be conceptualized as the gateway to information processing. Numerous processes, and their relations, must be intact if an individual is to pay attention effectively, and thus initiate processing of incoming information (Lezak et al., 2004; Strauss et al., 2006; White et al., 2009). Simple attention is a prerequisite for more complex types of attention, such as tracking and concentration. There is a degree of overlap between attention and other domains, particularly memory and executive functioning (Strauss et al., 2006).

Lezak et al.'s (2004)definitions of the different aspects of attention are paraphrased below:

1) *Focused* or *selective attention* (sometimes referred to as concentration) involves the ability to focus purposefully on one stimulus or several stimuli while suppressing the awareness of other potentially distracting stimuli.
2) *Tracking* is the ability to keep track of internal (mental) processes while performing goal-directed mental activity, such as repeating digits in reverse order of presentation.
3) *Sustained attention* requires attending to a selected stimulus over time.
4) *Divided attention* involves responding to two or more simultaneous tasks or two or more operations within the same task.

5) *Alternating attention* constitutes the ability to shift focus back and forth between two or more attentional tasks.

1.5.3. Processing speed

Processing speed is also referred to as *mental activity rate*, and indicates the speed at which mental activities and/or associated motor tasks are performed. Slowed processing speed is a sensitive and early indicator of the presence of neurological impairment (Lezak et al., 2004; Strauss et al., 2006).

1.5.4. Fine motor coordination

This term describes the ability to perform manual motor activities (fine motor rather than gross motor). Fine motor coordination tasks can be simple (e.g., finger tapping), or complex, requiring dexterity, coordination and speed (e.g., inserting pegs into a pegboard; Strauss et al., 2006).

1.5.5. Visuospatial abilities

Visuospatial abilities involve the processing and manipulating of nonverbal information. Visuospatial abilities are most commonly assessed with drawing or building/assembling tasks (Lezak et al., 2004; White et al., 2009). Drawing tasks assess the integrity of both the visual and motor systems, and free drawing tasks are more difficult than copying tasks (Lezak et al., 2004). Construction tasks, such as building a 2-dimensional replica of a pictorial image, assess spatial abilities as well as visual and motor components (Lezak et al., 2004). Visuospatial scanning is assessed in trail-type tests, and visuospatial reasoning may be assessed with matrix-reasoning type tests (Lezak et al., 2004; Strauss et al., 2006). Some visuospatial tests have a speed component (i.e., the participant scores better the quicker he/she completes the task; e.g., the Block Design subtests of the Wechsler scales). Other visuospatial tests (e.g., the Matrix Reasoning subtests of the Wechsler scales, and the Rey-Osterrieth Complex Figure Test do not feature such speeded performance goals.

1.5.6. Memory

Lezak et al. (2004, p. 414) describe memory as “the capacity to retain information and utilize it for adaptive purposes”. There are many explanatory models of memory (see details in Baddeley, 1996, 2000; Baddeley & Hitch, 1974; Cohen, 1997; Lezak et al., 2004; Strauss et al., 2006), but the major components described briefly below are widely accepted.

There are four interrelated memory processes (viz., registration, encoding, consolidation, and retrieval) and two primary memory systems (viz., working memory and long-term memory; Lezak et al., 2004; Strauss et al., 2006). *Encoding* involves the initial processing of incoming information (from external or internal sources). *Consolidation* involves strengthening the encoded or stored representations. *Retrieval* is the process of recalling or reproducing stored information, either freely, or with the use of cues (Lezak et al., 2004; Strauss et al., 2006). Cohen differentiates the terms *learning* (i.e., acquisition of new information) and *memory* (i.e., the consolidation and retention of acquired information; Cohen, 1997). The primary memory systems are further categorized into subdivisions.

1.5.6.1. Working memory

The terms working/short-term/immediate memory are used interchangeably (and somewhat confusingly) in the literature, and are also conceptually and functionally interrelated to attentional and executive processes. I refer to Baddeley and Hitch's (1974) description of *working memory* as a temporary holding or storage system which involves mental operations on the contents to ensure that the information remains available until it can be stored or encoded into the long term memory.

The working memory system employs a *central executive* that devises strategies regarding how to use information. The central executive supervises and is assisted by two slave systems (viz., the *phonological articulating loop* and the *visuospatial sketch pad*) which process verbal and visuospatial information, respectively (Baddeley, 1996, 2000, 2001; Baddeley & Hitch, 1974, 1994).

Working memory has a limited capacity, generally restricted to the storage of 7 (±2) units of information over the time span of approximately 30 seconds to 2 minutes (Lezak et al., 2004; Strauss et al., 2006). Subspan memory tasks do not initially overload memory capacity (e.g., digit span tests start with 2 items and incrementally expand the span). Supraspan tasks are intentionally intended to overload the memory capacity. For example, auditory verbal learning lists usually contain 15 items (Strauss et al., 2006).

1.5.6.2. Long-term memory

According to Schacter and Tulving's (1994) conceptualization, long-term memory can be subdivided into declarative and nondeclarative systems. *Nondeclarative* memory systems are not traditionally measured. Most measures of memory are, in fact, measures of *declarative* *episodic memory*, and involve the conscious and active recall and recognition of new information (Strauss et al., 2006). Tests used in this study measure verbal and nonverbal episodic memory.

1.5.6.3. Other terms related to memory

Registration (also referred to as sensory memory) is the process preceding encoding, during which incoming information is held briefly (i.e. milliseconds) in the sensory store. Visual images last up to 200 milliseconds in the iconic memory. *Echoic memory*, which replays auditory information, has a maximum capacity of 2000 milliseconds (Lezak et al., 2004). *Visual memory* refers to the recollection of visually presented stimuli, and verbal memory refers to the recollection of stimuli that are presented in the auditory modality (Lezak et al., 2004). Visual memory tasks usually involve the reproduction of pictorial designs. *Verbal memory* tasks traditionally involve word lists or stories. Word-list learning is considered to be more sensitive than story learning because of its relative freedom from an associative context with inherent cues to guide recall (Lezak et al., 2004).

1.5.7. Executive functioning

Executive functioning (EF) has been widely acknowledged as a multidimensional rather than a unitary construct. Different components of EF act together in a supervisory capacity during the process of purposeful, goal-directed behavior in novel situations, where new problem-solving strategies are required (Alvarez & Emory, 2006; Lehto, 1996; Lezak et al., 2004; Strauss et al., 2006; Stuss & Alexander, 2007; Sugarman, 2002; Varney & Stewart, 2004; Zelazo, Müller, Frye, & Marcovitch, 2003). Although the problems in measuring EF have been articulated by many authors, Strauss et al. (2006)provide some useful recommendations regarding how to counteract the difficulties:

1) EF processes are not unitary, but involve subsystems of functioning that are somewhat separable. It is thus necessary to identify which particular element of executive functioning is the target of investigation.
2) There is a degree of overlap between EF and many cognitive functions, particularly fluid intelligence. It is thus important to establish the pattern of deficits across measures when interpreting performance on EF measures.
3) EF tasks also measure other domains so it may be difficult to tease out exactly what is being measured. It is preferable to select simpler tasks, which isolate the processes underpinning performance.

4) EF tests have consistently demonstrated lower reliability compared to measures of other cognitive domains. Using multiple executive tests is helpful in establishing a pattern of EF.
5) Because EF tests generally have questionable construct validity, it is important to interpret test results in the context of collateral information. It is recommended that assessors supplement information from behavioural rating scales and/or interview teachers and caregivers. This may provide insights about how participants tend to perform in social and educational contexts requiring novel problem-solving abilities and self-monitoring.

Because EF continues to develop during adolescence (as explained in Section 1.4.), I have used Peter Anderson's (2002) model of EF as a framework around which to organize the subdomains of cognitive functioning assessed by the EF tests in the current battery. Anderson based his model on factor-analytic studies and clinical neuropsychological findings in children and adolescents. This model defines executive functioning as a process during which four discrete but related subdomains operate in an integrated manner as a supervisory or control system. The four subdomains are: 1) attentional control; 2) information processing; 3) cognitive flexibility; and 4) goal setting.

Attentional control includes the abilities to attend selectively to target stimuli, to focus attention for the task duration, to inhibit prepotent responses, and to monitor one's actions and errors in order to complete tasks effectively in the context of given parameters. *Information processing* refers to how quickly, efficiently, and fluently tasks are performed and completed. *Cognitive flexibility* involves using working memory, initiating problem solving strategies, shifting response sets, dividing attention, and adapting performance according to errors and changing demands. *Goal setting* involves the ability to initiate, plan, and maintain effective organization during the problem-solving process.

1.6. Test selection criteria

One of the major questions facing South African clinicians is whether to use cognitive tests developed and standardized in other geographical locations, such as North America and the United Kingdom (i.e., non-local tests), or to use locally developed instruments (Boon & Steel, 2005; Claassen, 1998; Herbst & Huysamen, 2000; Nell, 1994; Rushton, 2008; Skuy et al., 2001). The answer seems to depend on a variety of factors, including 1) the specific test population's relative position on a continuum of Westernization, urbanization and literacy,

2) the extent to which investigators are sensitive to (but not misguided by) the potential for cultural bias, and 3) how well racial and sociodemographic factors such as socioeconomic status, and level and quality of education, are taken into consideration when interpreting test results (e.g., Foxcroft, 1997; Kanjee, 2005; Nell, 2000; Shuttleworth-Edwards et al., in press). For example, Shuttleworth-Jordan (1996) demonstrated that the rejection of non-local test usage in black subjects, on the grounds of race *per se*, was unnecessary as urbanized black students attending an English medium university demonstrated mean scores in the normal range in relation to Lezak's (1983) non-local norms.

Subsequently, other South African researchers have used non-local tests, adopting varying methodological approaches, with relative strengths and limitations. One approach is to use non-local tests without translation or without substantial adaptation of test material, other than minor terminological changes such as converting currency and metric terms to South African versions (e.g., Grieve & Viljoen, 2000a; Shuttleworth-Edwards, Kemp et al., 2004). This approach is advantageous for cross-cultural comparisons because differences in performance cannot be attributed to variations in test material or to variations in administration procedures (Mitrushina et al., 2005). Disadvantages of this approach are that test performance may be adversely affected by unfamiliarity with test items and terminology (Agranovich & Puente, 2007; Cofresi & Gorman, 2004; Grieve & van Eeden, 2010b; Kanjee, 2005; Nell, 2000). Untranslated test material and instructions are highly problematic in situations where discrepancies exist between the competency of the participant in the test language and the sophistication of the language used in the test material and instructions (Brickman, Cabo, & Manly, 2006; T. M. Wong, 2006; T. M. Wong & Fujii, 2004).

Another approach is to use translated but unadapted non-local test stimuli and instructions (e.g., Jansen & Greenop, 2008; Van der Merwe, 2008). The efficacy of this approach is contingent on the quality of the translation process and product. The use of informal oral translations by interpreters during testing is subject to considerable variability, which compromises the validity of standardized tests (Carter et al., 2005; Foxcroft & Roodt, 2005; Mitrushina et al., 2005). Consequently, it is preferable to use formal written translations that have been independently back-translated and reconciled for semantic differences (Brickman et al., 2006; Brislin, 1983; Siedlecki et al., 2010).

The approach to non-local test usage that is internationally considered to be most suitable in terms of minimizing the impact of cultural and linguistic bias (Ardila, 2007; Braga, 2007;

Cofresi & Gorman, 2004; Ostrosky-Solis, Ramirez, & Ardila, 2004; T. M. Wong, 2006; T. M. Wong & Fujii, 2004) is to both translate and to adapt test material (e.g., Jinabhai et al., 2004; Knoetze et al., 2005). A limitation of this approach is that until psychometric equivalence between original and adapted tests has been established, such tests should be regarded as experimental, and test results should be interpreted with due caution (C. D. Foxcroft, 2005; Mitrushina et al., 2005).

The appropriateness of the methodological approach to using non-local tests is context-specific in relation to the characteristics of the test, the intended test population, and the purposes of assessment. I elected to use non-local tests for the following reasons: credibility within the international scientific community; access to the body of accompanying peer-reviewed literature; compliance with standards imposed by research funding institutions and agencies; potential for cross-cultural comparisons; utility in providing a baseline for the identification and modification of culturally-biased test items; current wide usage in South Africa despite the absence of demographically-appropriate norms (Foxcroft, 2004; Grieve, 2005; Razzouk et al., 2010; Shuttleworth-Edwards et al., in press; Shuttleworth-Jordan & Bode, 1995; Skuy et al., 2001). In the interests of minimizing linguistic bias, I adopted Brislin's (1983) rigorous approach to translation. In consultation with cultural and linguistic experts, I evaluated all test material for suitability of use in the local population, and adapted material for some of the tests accordingly, thus using a combined approach of translated and adapted/unadapted test material.

1.6.1. Psychometric credibility

According to the South African Employment Equity Act 55 of 1998 (South African Government, 1998), any psychological measures have to meet two basic psychometric requirements, viz., reliability and validity. I selected tests that had, in the contexts in which they were developed, demonstrated reliability and validity. This work sets out to establish their validity in our local setting.

1.6.1.1. Reliability

If a test measures a construct accurately and consistently with repeated administrations, it is described as *reliable* (Owen, 1996; Wolfaardt & Roos, 2005). It is not possible to know an individual's true score on psychological constructs. Consequently, measuring the reliability of psychometric tests involves taking the potential for error variance into consideration. This is done by calculating a correlation coefficient, which expresses the ratio between true and observed score variance (Wolfaardt & Roos, 2005). The reliability coefficient ranges from 0 to

1, with higher scores representing higher levels of confidence in the accuracy and stability of the measure (Huysamen, 1996; Owen, 1996).

Although it is preferable to report multiple measures of reliability, this rarely occurs in test manuals. I reported published test-retest reliability of the selected tests. *Test-retest reliability*, also referred to as *temporal stability*, measures the extent to which scores remain stable in the same individuals over repeated occasions (Owen, 1996; Wolfaardt & Roos, 2005). The recommended retest interval period to establish test-retest reliability is at least 2 weeks. There is a possibility that, under certain circumstances, memory effects may confound results in shorter intervals and that other factors (including the potential for real change in the domain being measured) may intervene in longer intervals (Owen, 1996).

Opinions differ regarding an acceptable test-retest reliability coefficient. Many authors recommend that the purpose and context of the test dictate what should be considered as acceptable, and rates may thus vary considerably, for example, between .30 and .90 (e.g., Anastasi, 1982; Huysamen, 1996; Wolfaardt & Roos, 2005). Stringency criteria tend to differ according to whether the interpretation refers to groups, for example, .65, or to individuals, for example, .85 (Owen, 1996a, 1996b; Wolfaardt & Roos, 2005), and greater leniency is permissible for newly-developed or adapted tests (Sattler & Dumont, 2004). Strauss et al. (2006) provide guidelines for evaluating the magnitude of reliability coefficients according to the following guidelines: low (< .59); marginal (.60 - .69); adequate (.70 - .79); high (.80 - .89); and very high (≥ .90).

1.6.1.2. Validity

A test cannot be valid if it is not reliable, but if a test is reliable, it is not necessarily valid (Wolfaardt & Roos, 2005). *Validity* indicates the extent to which a test measures what it claims to measure (Llorente et al., 2003; Owen, 1996a; Van Den Berg, 1996). As with types of reliability, there are various types of validity (e.g., content-related; concurrent; face; criterion-related; and predictive) that lie beyond the scope of this dissertation (see texts for details; Llorente et al., 2003; Owen, 1996a; Strauss et al., 2006; Van Den Berg, 1996).

Some authors have proposed that construct validity encompasses all types of validity, and that the term *construct* validity is redundant (Anastasi, 1982). Here I use the term to differentiate it from other types of validity. *Construct validity* indicates the extent to which tests measure the domains they claim to measure, for example, whether the Grooved Pegboard Test measures fine motor coordination (van den Burg & Kingma, 1999). Construct validity can be established in numerous ways: for example, it might be measured by correlation with other tests which purport to measure the same domain; and by factor analyses of the dimensions that tests measure (van den Burg & Kingma, 1999; Wolfaardt & Roos, 2005).

Whether or not a test is valid depends on what it is being used for. For example, the ROCFT (Meyers & Meyers, 1996) could be used to measure executive functioning or visual memory and might be a valid measure of one, but not the other. It is not possible to establish validity with a once-off measurement. Rather, establishing test validity is an imperfect and ongoing process that begins with initial validation and continues indefinitely with the use of the test in different contexts (Huysamen, 1996, 2002; Psychological Corporation, 1999; Van Den Berg, 1996; Wallis, 2004).

Generally speaking, tests demonstrate construct validity by meeting two criteria: 1) they correlate highly with other measures that theoretically measure the same construct; and 2) they correlate minimally with measures that are supposed to measure other constructs (Wolfaardt & Roos, 2005). As with reliability, opinion varies regarding the acceptable magnitude of validity coefficients. Unlike reliability coefficients, validity coefficients in the human sciences rarely reach levels of .40. Validity levels as low as .20 are sometimes regarded as acceptable, but more commonly, rates of .30 are considered acceptable (Strauss et al., 2006; Wolfaardt & Roos, 2005).

In sum, all the tests I selected were non-local tests that were regarded as clinically and psychometrically credible by the authors of one or more of the core neuropsychological texts cited previously. Furthermore, I endeavoured to select tests that are regarded to be appropriate for use in the demographic profile of my study population.

1.6.2. Contextual appropriateness

The international guidelines for ethical assessment (set by the International Test Commission) dictate that “the assessment practitioner will use tests appropriately, professionally, and in an ethical manner, paying due regard for the needs and rights of those involved in the testing process, and the broader context in which the testing takes place”(International Test Commission, 2001, p. 7). The need to select tests that are culturally-, linguistically-, educationally-, and age-appropriate is implicit in the international guidelines.

1.6.2.1. Age appropriateness

Many cognitive tests were designed for adults, and are consequently not appealing, motivating, or appropriate for children or adolescents. Designing tests that captivate and engage adolescents is particularly challenging (V. Anderson, Northam et al., 2001; Golden, Freshwater, & Golden, 2003). Cocodia et al. (2003) made a particularly pertinent observation here, noting that recent cohorts of children and adolescents appear to have lowered attention spans and that performance on cognitive tests may therefore be related to the entertainment value that they afford. Tests with a game-like format, for example the Tower of London (ToL; Culbertson & Zillmer, 2001) provide the opportunity to measure executive functioning in a way that is enjoyable for adolescents.

Tests that were specifically designed within the paradigm of developmental psychology, for example, the Children's Memory Scales (CMS; Cohen, 1997) are generally recommended over those that are downward extensions of tests developed for adults (P. Anderson, Anderson, & Lajoie, 1996; V. Anderson, 1998; V. Anderson, Northam et al., 2001). However, there is empirical evidence to suggest that some adult tests are successfully transferable to child and particularly to adolescent populations, and are successfully employed with younger participants, for example, the ROCFT, which is a multimodal instrument capable of measuring executive functioning, visuospatial ability, and visual memory (Meyers & Meyers, 1996).

One of the factors inhibiting a thorough understanding of developmental differences is that there are only a few tests available with sufficiently broad age-bands. This lack of understanding limits the extent to which performances can be compared over time (Golden et al., 2003; Quinn & Quinn, 2005; D. P. Waber et al., 2007). The Wechsler Abbreviated Scale of Intelligence (WASI; Psychological Corporation, 1999), with its capability to test 8- to 89-year-olds, is an example of a cognitive measure well suited to the adolescent population, with excellent longitudinal utility.

1.6.2.2. Cultural and linguistic appropriateness

Local and international data attest to the potential for cognitive test results to be adversely affected by culturally or linguistically-biased test material (Ardila, Ostrosky-Solis, & Bernal, 2006; Cofresi & Gorman, 2004; Fujii & Wong, 2007; Manly, Byrd, Touradji, & Stern, 2004; Manly & Echemendia, 2007; Razani, Murcia, Tabares, & Wong, 2007; Rushton, 2008; Skuy, Taylor, O'Carroll, Fridjhon, & Rosenthal, 2000). Where possible, I selected tests that had been specifically designed with the intention of reducing cultural bias. For instance, the Children's

Color Trails Tests (CCTT) as a measure of attention (Llorente, Williams, Satz, & D'Elia, 2003), and Maj's Auditory Verbal Learning Test (MAVLT; Maj et al., 1993; Maj et al., 1994) as a measure of verbal memory have been shown to be relatively impervious to cross-cultural effects. Similarly, I selected tests with the potential for adaptation or removal of biased items, for example, the verbal subscales of the WASI (Psychological Corporation, 1999).

I preferred to use tests with demonstrable cross-cultural utility, as defined by inclusion in Mitrushina et al.'s (2005) meta-analytic studies. Examples include the Grooved Pegboard Test (GPT; C. G. Matthews & Klove, 1964) as a measure of fine motor coordination and psychomotor speed; the Stroop Color-Word Test (SCWT; Golden et al., 2003) as a measure of particular aspects of executive functioning, particularly response inhibition and selective attention response inhibition; and the ROCFT (Meyers & Meyers, 1996) as a (previously described) multimodal test.

1.6.2.3. Pragmatic criteria and resource-building

In addition to selecting high-quality non-local tests, suitable for the local test population and for cross-cultural purposes, tests were also selected for pragmatic reasons. For example, I preferred tests that were time-efficient, financially affordable within the constraints of the budget of the primary study, easy to transport, and relatively impervious to administration and scoring inconsistencies.

In order to build the database of non-local tests with local norms, I restricted the use of tests that had already been normed for the age range, language, and racial characteristics of the test population. For example, the WISC-IV (Wechsler, 2004) had been normed for use in white English- and Afrikaans-speaking, and coloured Afrikaans-speaking, 12- to 13-year-old, Grade 7 learners in the Eastern Cape (Shuttleworth-Edwards et al., in press). I did, however, use some previously-normed material (specifically, the WISC-IV Coding subtest, as a measure of processing speed), which facilitated the evaluation of inter-provincial generalizability of this particular subtest.

The tests selected to measure the cognitive domains are described in the methods (Section 2.4.2.), which also provides details regarding the psychometric properties and clinical utility of each test. I also describe the idiosyncratic test selection criteria not encapsulated in the general criteria described above. In addition to suitable test-selection, the efficacy of cognitive assessment is dependent on the quality of each of its components, including the extent to which non-neurological factors (which impact on test results and interpretation thereof), are controlled.

1.7. Non-neurological factors that affect cognitive assessment

1.7.1. Administration procedures

It is important that standardized test administration procedures are followed, in order to maintain test validity (Cohen, 1997; Psychological Corporation, 1999). Ideally, instructions should be consistent and narrated verbatim. Timing restrictions, practice attempts and provision of specific feedback should be enforced according to the prescribed specifications; and original material should be used. Deviations from protocols compromise the validity of the instruments and their generalizability (Cohen, 1997; Psychological Corporation, 1999). In certain contexts, adaptations are necessary and appropriate. Any deviations from standard test administration procedures or materials should be acknowledged, and the test should be considered to be an experimental version (Mitrushina et al., 2005).

1.7.2. Test setting

The test setting should be conducive to eliciting the best possible performance by the participant. It should thus be quiet, well ventilated and lit, and as free as possible from distractions or interference. The test space should be arranged so that the participant is comfortably seated at a table of the appropriate height and with a smooth surface (Cohen, 1997; Mitrushina et al., 2005; Psychological Corporation, 1999).

Most test designers advocate that only the participant and the examiner be present in the room. Opinion is divided about whether or not to allow recording devices (visual and/or audio). Some advocate their use for accuracy (e.g., Cohen, 1997), and others discourage their use due to the enhanced potential for atypical performance and to safeguard the integrity of test material (e.g., Mitrushina et al., 2005; Psychological Corporation, 1999). Others suggest that decisions regarding the presence of an observer and the use of a recording device are contingent on the context (e.g., Wong & Fujii, 2004). For example, the presence of third parties such as examiners, supervisors, interpreters, lawyers, caregivers, and family members is sometimes required. For the purposes of collecting normative data, it is important that the same procedure is followed for all participants, regardless of which decisions have been made.

1.7.3. Rapport

Establishing rapport is important to engage the participant and to elicit optimal cooperation and best possible performance for the test duration (Lezak et al., 2004; Mitrushina et al., 2005; Strauss et al., 2006; Wechsler, 2004). The examiner's ability to establish rapport and simultaneously remain task-focused within the appropriate parameters of a formal testing situation depends to a certain extent on training, experience and personal characteristics. However, test authors generally provide tips on how to establish and maintain rapport. They also specify the types of feedback that are permissible to encourage the participant, regardless of the quality of their performance, without compromising standard test procedures (e.g., Cohen, 1997; Culbertson & Zillmer, 2001; Golden et al., 2003; Psychological Corporation, 1999; Wechsler, 1991).

1.7.4. Scoring

Test scoring procedures vary in complexity. Tests with ambiguous or unclear scoring instructions, those requiring complicated calculations, or those prone to examiner bias, are likely to yield questionable results. Although computerized scoring procedures may reduce the incidence of scoring errors, simple clerical errors can have profound effects on test scores. Charter et al. (2000) demonstrated that even qualified, well-trained, and experienced testers are not immune to making clerical errors that compromise the utility of the test results. In the scoring of the ROCFT, for example, simple clerical errors while doing addition, transferring numbers, using conversion tables, plotting scores on a profile sheet, and entering data were made in 22% of tests scored. It is thus advisable to have cross-checking procedures, or to duplicate scoring and data entry protocols to guard against these types of errors.

1.7.5. Interpretation of results

Anderson (2001) suggests that meaningful assessment involves the evaluation of mastery (endpoint scores), strategy (qualitative evaluation of process), and rate (processing speed). For example, when evaluating performance on the ROCFT Copy subtest, it would be advisable to consider not only the accuracy score, but also the organizational strategy and the completion time (P. Anderson, Anderson, & Garth, 2001).

In addition, cognitive test scores should never be interpreted in isolation. Findings should be evaluated in the context of other test results and of current and historical details (including pre- and perinatal periods) that characterize the individual. Examples of relevant contextual factors include history (psychosocial, familial, developmental, medical, legal and educational), personality characteristics, emotional state, and linguistic ability. Furthermore, this information needs to be collected from a variety of sources, including the test results and behaviour, and collateral information from families, cohabitants, educators, and other medical practitioners (Lezak et al., 2004; Mitrushina et al., 2005; Strauss et al., 2006).

1.7.6. Influential demographic and cultural factors

International research has shown that there are numerous potentially confounding variables that might affect cognitive functioning. Disentangling the extent to which numerous and often highly inter-related factors affect cognitive functioning is challenging (Ardila et al., 2006; Braga, 2007; Mitrushina et al., 2005; Ogden, Cooper, & Dudley, 2003; Ostrosky-Solis, Ramirez, & Ardila, 2004; Ostrosky-Solis, Ramirez, Lozano, Picasso, & Velez, 2004; Rosselli & Ardila, 2003; Rosselli, Ardila, Bateman, & Guzman, 2001).

Ardila (1995) provides a theoretical distinction between race as a biological and unchangeable factor, in contrast to sociocultural factors, which are capable of fluctuation. Shuttleworth-Jordan (1996) elaborates on the dynamic nature of sociocultural factors, and explains how the suitability of non-local tests is contingent on the subjects' relative position on an acculturation spectrum, with non-local tests being more appropriate for participants who are more urbanized, literate, and Westernized, and who have higher exposure to and competency in the English language.

In this work, I refer to factors known to affect cognitive test performance that are *constant* (i.e., race and sex), or *changeable*. Changeable factors include age and cultural factors (referred to as a broad umbrella term), for example, language, level and quality of education, socioeconomic status and urbanization.

1.7.6.1. Race

Cross-cultural research has grappled with how to understand, interpret, and report widely observed inter-racial differences in cognitive performance (Nell, 2000; Rushton, 2002, 2008; van de Vijver, 2008; T. M. Wong, 2006; T. M. Wong & Fujii, 2004). Opponents of race-based norming argue that such practices perpetuate racial stereotyping and stigmatization (e.g., Gasquoine, 2001; Helms, Jernigan, & Mascher, 2005). Others argue that racial differences need to be interpreted in the context of the relative influence of inter-related changeable factors (Ardila, 2005; Brickman et al., 2006; Elkonin, Foxcroft, Roodt, & Astbury, 2005; Siedlecki et al., 2010; Clifford van Ommen, 2005a). Owen (1992, p. 62) elaborates on the latter philosophical approach by explaining that "the differences in mean test scores which are usually found between white and black testees in South Africa are probably largely a reflection of the enormous differences in socio-economic conditions and educational opportunities which have existed, and still exist, between these groups".

Shuttleworth-Jordan (1996) observed that, on an eclectic collection of non-local cognitive tests, the scores for African-language university students, though marginally lower than those of English-language students, were equivalent to Lezak's (1995) North American norms. These findings, and a series of case illustrations in the same paper, demonstrate that the tendency to explain away lowered scores on the basis of racial or cultural differences may obscure real pathology. The implications of these findings are that the heterogeneity of performance within racial groups needs to be acknowledged, and that the injudicious upward adjustment of scores on racial grounds *per se* elevates the potential for false negative misdiagnoses.

Mitrushina et al. (2005) recommend that normative researchers provide detailed descriptions of constant and changeable variables; investigate the relative impact of such factors on cognitive test performance; and stratify norms accordingly. The purpose of this sort of characterization of data is to enable clinicians to make informed choices regarding the selection of norms that best match the subjects under investigation. In multiracial societies, some understanding of the interaction between race and attenuating changeable factors (e.g., cultural and linguistic heterogeneity and quality of education) is necessary to be able to comply with the abovementioned recommendations.

1.7.6.2. Cultural heterogeneity

The concept of *culture* is overarching and difficult to define operationally. The Oxford English dictionary (Soanes & Stevenson, 2006, p. 349) defines culture as: "the integrated pattern of human knowledge, belief, and behavior that depends upon the capacity for learning and transmitting knowledge to succeeding generations". Ardila (2005, p. 185) defines culture as "the set of learned traditions and living styles, shared by the members of a society" that include thinking, feeling, knowledge, attitudes and beliefs, which represent particular ways in which people adapt to environmental conditions. The cognitive testing experience is one such environment, and Ardila provides extensive evidence of why and how culture may impact on test performance. Cross-cultural research has illustrated that dynamic and diverse historical and cultural factors (e.g., geographical location, urbanization, language, socioeconomic status, access to and quality of education, exposure to test-taking experiences) impact on cognitive test performance (e.g., Braga, 2007; Brickman et al., 2006; A. L. I Fortuny, Garolera, Hermosillo Romo et al., 2005; Manly, 2008; Ostrosky-Solis et al., 1985).

I use the term *cross-cultural* in a generic sense, to indicate comparisons between groups of people who differ with regard to one or more constant and/or changeable elements. Such comparisons can be made directly, by actually testing different cultural groups within the same research protocols, or more indirectly, by comparing group performances using norms collected from different studies (Mitrushina et al., 2005; Strauss et al., 2006). In this study, I use a combination of direct and indirect cross-cultural comparisons. For example, direct *intraregional* comparisons are made between coloured and white participants with advantaged quality of education. I make indirect comparisons between cognitive scores from the study samples with *international* norms (e.g., from North America), *intracontinental* norms (e.g., from other African countries), and *interprovincial* norms (e.g., from other regions in South Africa).

The dilemmas of testing in culturally heterogeneous (e.g., racially, linguistically, culturally, and economically diverse) societies are well known to, but not exclusive to, South Africans. In Cameroon, for example, there are 200 regional language dialects (Ruffieux et al., 2010), and in Kenya, although there are only 2 official languages, 61 other languages are widely spoken (Carter et al., 2005). The Gini coefficient (which is a changeable rating scale that measures the discrepancy between privileged and underprivileged economic sectors) rates South Africa in the top ten countries demonstrating the greatest degrees of socioeconomic heterogeneity (Monteiro, 2008; Urbach, 2007). The implications are thus that there are countries that are faced with similar contextual complexities for psychometric testing.

There is encouraging evidence to suggest that it is possible to preserve test reliability and validity in cross-culturally modified international tests (Holding et al., 2004; Mulenga, Ahonen, & Aro, 2001; Pontón & Leon-Carrion, 2001; Shuttleworth-Jordan, 1996). For example, a study based in Uganda showed that 8 out of 11 translated and adapted borrowed tests were valid and reliable in testing 5-year-old semi-urban Ugandan children (Nampijja et al., 2010). Internationally, considerable attention and expertise has been devoted to the establishment of culturally, linguistically, and contextually-appropriate normative data bases (Agranovich & Puente, 2007; Braga, 2007; Cofresi & Gorman, 2004; Gasquoine, 2001; Mitrushina et al., 2005; Royall et al., 2003; van den Burg & Kingma, 1999; T. M. Wong & Fujii, 2004).

1.7.6.2.1. Assessing cultural bias

Methods used to ascertain whether a test is culturally fair include: merely making assumptions; conducting informal appraisals (for example, gathering informal opinions regarding the suitability of the test material); and conducting pilot studies that empirically evaluate the suitability of the test within the specific cultural sectors (Brickman et al., 2006; Carter et al., 2005; Kanjee, 2005). In the process of adapting tests, I utilised guidelines for minimizing cultural bias recommended by the International Test Commission (summarized in Kanjee, 2005, p. 65). These guidelines include strategies such as consultation with cultural experts and well qualified translators, conducting pilot studies, refining test material according to preliminary findings, reporting norms, and describing methodology.

There are many examples of successful cross-cultural utilization of non-local tests, for example, in English-speaking Kenyans (Holding et al., 2004); Mandarin-speaking Chinese (Hsieh & Tori, 2007); Cantonese-speaking Hong Kong Chinese (T. M. Lee, Yuen, & Chan, 2002); and Japanese (Matsui, Arai, Yonezawa, Tanaka, & Kurachi, 2007). Some tests have demonstrated more cultural bias than others. Clock drawing tasks, for example, have been found to be culturally fair for Hispanic American (Royall, Cordes, & Polk, 1998; Royall et al., 2003), Greek (Bozikas, Giazkoulidou, Hatzigeorgiadou, Karavatos, & Kosmidis, 2008), and Chinese Singaporean (Yap, Ng, Niti, Yeo, & Henderson, 2007) adult populations. Other tests, such as the ROCFT, have obtained mixed reviews, being deemed suitable for Italian adults (Caffarra, Vezzadini, Dieci, Zonato, & Venneri, 2002) and Japanese children (Watanabe et al., 2005), but not for Colombian adults (Rosselli & Ardila, 1991). Demonstrable cross-cultural differences have been found for other tests, for example the Arabic version of the SCWT in Kuwaiti students (Alansari & Baroun, 2004).

Previous assumptions that nonverbal tests are free from racial and cultural bias, and that ethno-cultural factors could be controlled with the elimination of verbal items, have been disconfirmed (Rosselli & Ardila, 2003; Shuttleworth-Edwards, Kemp et al., 2004). Raven's Matrices, for example, have been found to be biased against black Africans (Cronshaw, Hamilton, Onyura, & Winston, 2004; Jinabhai et al., 2004; Knoetze et al., 2005; Nell, 2000).

There are some findings of domain-specific cross-cultural differences. In a study comparing performance in participants from a wide age span (8-90 years) in five countries (USA, Canada, Ecuador, Ireland, Israel), Levav et al. (1998) found that reaction times and simple attentional tasks were unaffected by either country of origin or level of education. There were, however, cross-site differences in performances on tasks involving set-shifting, response inhibition, and problem-solving.

1.7.6.2.2. Subcultural effects

Cross-cultural assessment is also complicated by heterogeneity within cultural groups, and by constantly changing socialization structures (Foxcroft, 1997, 2002; Jinabhai et al., 2004; Rosselli, Tappen, Williams, Salvatierra, & Zoller, 2009; T. M. Wong & Fujii, 2004). The need for ongoing evaluation of the adequacy of the extent to which tests and norms characterize the individuals being assessed has been emphasized. Even within the same geographical location, the effects of differences in subculture have been found to be significant.

For example, Jukes and Grigorenko (2010) found that performance of Gambian adolescents (14-19 years) on digit span tasks differed between two different ethnic groups who used different base units for counting. Digit span for the Wolof (who count in bases of 5) was shorter than that of the Madinka (who count in bases of 10) for tasks using numbers 1-9, but not when using numbers 1-5. Similarly, recall of digits has been affected by the length of syllables in digit names. Spanish digits are phonologically longer than English digits (Gasquoine, Croyle, Cavazos-Gonzalez, & Sandoval, 2007), and English digits are longer than Mandarin digits (Chen, Cowell, Varley, & Wang, 2009), resulting in differences in performance relative to digit length. In our context, digits from 1 to 10 are identical in length in Afrikaans and English, so inter-lingual differences in digit span measures are unlikely to be attributable to syllable length. If, however, digit span were to be measured in Xhosa, performance would be complicated by syllable length, word structure, and by conceptual differences in counting systems.

1.7.6.2.3. Test-taking attitude and experience

Test performance may also be affected by the extent to which the tasks and their associated achievement components are considered to be culturally meaningful or significant in the testing population (Cofresi & Gorman, 2004; Grieve, 2005). The emphasis on speed, for example, is not considered to be important in all cultures (Ardila, 2005; Brickman et al., 2006; Foxcroft, 2002). Ardila (2005) points out that in many cultures, speed and quality may be at cross-purposes; some cultures, for instance, may regard good products as those resulting from slow and careful planning processes. Nell (2000) hypothesizes that observed differences between South Africans and North Americans in speeded tests is partially because the latter population attach greater value to speed, and consequently have greater exposure to tests constrained by speed limits, from primary school onwards. Cross-cultural comparisons between North

Americans and other cultures, for example New Zealand Maoris (Ogden, Cooper, & Dudley, 2003), Hispanics (Rosselli & Ardila, 2003; Rosselli et al., 2000), Aruaco Indians (Ardila & Moreno, 2001), and Russians (Agranovich & Puente, 2007), have demonstrated slower performances by non-Americans in time-restricted cognitive tests, possibly due to differing value systems.

In cross-cultural contexts, tests do not always measure aspects of functioning that are meaningful in real-world situations. For example, Brazilian children who demonstrated sophisticated computational and problem-solving abilities when selling sweets on the street, performed poorly in classroom mathematical tests (Saxe, 1988). Furthermore, Westernized psychometric measures of intelligence fail to capture the diverse expressions of other aspects of adaptability. For example, *practical* intelligence, which involves taking responsibility for real-world problem solving such as buying and selling, resolving peer and sibling conflict, and developing a sense of responsibility for care of others and the home, is highly valued in the Cameroonian Kpe culture (Tande, 2010).

Participants from different cultures evince different levels of test-wiseness, including factors such as: comfort in a formal testing situation (in some cultures, for example, it is unusual and sometimes inappropriate for adults to elicit the opinions of children or adolescents, as is required in formal testing situations; Carter et al., 2005)); attitudes regarding the relative importance of accuracy and speed (Grieve, 2005); familiarity with test materials and experience with and exposure to graphomotor tasks (Cofresi & Gorman, 2004; Foxcroft, 1997; Grieve, 2005). For example, Barry (2010) found that rural Senegalese children have very little exposure to pictorial stimuli. Not one home in Barry's study had a picture book, but children were richly exposed to oral stimuli (e.g., songs, nursery rhymes, and recitations of genealogy and Koranic verses).

1.7.7. Historical issues in psychometric testing in South Africa

Although I do not attempt to provide a detailed political discourse, it is necessary to highlight the impact of *Apartheid* policies with regard to language and education on psychometric testing in South Africa. Implementation of the Apartheid ideology spawned communities that were previously disadvantaged. However, as Skuy et al. (2001) argue, the term *previously disadvantaged* is a misnomer: despite political changes, factors such as unemployment, limited and disorganized educational facilities, impoverished and unsatisfactory living conditions and poor nutrition continue to contribute to *ongoing* disadvantage in certain sectors of society.

1.7.7.1. Language policies

Apartheid language policy dictated dual-medium education in Afrikaans and English, regardless of mother tongue, or of the level of proficiency in these languages in either learners or educators (Mesthrie, 2002; Meyerhoff, 2006). Since democratization in 1994, previously marginalized languages have been included in the ensemble of 11 official languages. Policy-makers have also formally recognized the value of mother-tongue education (Meyerhoff, 2006).

However, despite changes in educational language status and policy, many South African children continue to be educated in their second or third language. This situation is partially attributed to the lack of teachers who are both adequately qualified and proficient in the required language (C. D. Foxcroft, 1997). Other reasons for other-language education include parental aspirations for their children to be educated in English. Learners who switch language of tuition are sometimes doubly disadvantaged in that the development of competence in both languages is compromised (Grieve, 2005). In such cases, the associated difficulties tend to persist, even with remedial efforts (Matafwali, 2010).

Previous language policies have affected attitudes toward language. For instance, Afrikaans has been associated with the language of the oppressor (Scheffer, 1983). In contrast, English has been associated as the language of upward mobility, even, for example, in some sectors of the Afrikaans-speaking coloured community (Hemp, 1989; Scheffer, 1983). It is possible that first-language acquisition in many South African children has been affected by these factors. This is of concern, because poor language skills are strongly associated with poorer cognitive functioning and negative sequelae such as low academic achievement and reduced employment opportunities (Mesthrie, 2002; Meyerhoff, 2006).

1.7.7.2. Education policies

During Apartheid, education policies dictated that schools were segregated, classified, and allocated resources according to race. Black, coloured, and Asian children were allocated fewer materials and human resource than whites, for example, coloured and black schools were allocated 43% and 4%, respectively, of the funds allocated to white schools (Corke, 1984). The unequal distribution of these resources was demonstrable in higher teacher-learner ratios, less qualified teachers, fewer educational materials and facilities, location of schools in economically less affluent areas, and inadequate access to transportation to schools (van der Berg, 2002; van der Berg & Burger, 2003).

Since democratization, options for better education have become increasingly accessible for some children, school attendance has increased, and resources have been redistributed to underprivileged sectors. But despite such attempts to redress the imbalances of the past, education attainment levels still appear to follow the past racial patterns, with poorest performances exhibited by predominantly black, followed by coloured schools (Case & Yogo, 1999; Statistics South Africa, 2001; van der Berg & Burger, 2003). In comparison with the other South African provinces, the Western Cape, where this study is located, fares best, according to matriculation (Grade 12) pass rates, eligibility for tertiary education, and high achievements (i.e., aggregates of 80% and above; van der Berg, 2001, 2002; van der Berg & Burger, 2003).

South Africans have generally fared poorly relative to other African countries in international tests of mathematics, science, and numeracy, for example, the worst out of nine participating countries in the latter (van der Berg & Burger, 2003). In an assessment of literacy in sub-Saharan Africa (Zhang, 2006), only between 1 and 37% of children with 6 years of education had reached desirable reading levels, and 22 to 65% were reading at a minimal level, in accordance with international standards. Literacy levels in South African children were better than those from Namibia, Uganda, Zambia and Zanzibar, but worse than those from Botswana, Kenya, Mauritius, Mozambique, Seychelles, Swaziland and Tanzania. Children from rural areas performed worse than those from urban and peri-urban regions.

Reading levels of South African children from disadvantaged communities are very poor, which may be partially accounted for by the low literacy rates of their parents (Patel, 2009). The cumulative effects of inferior quality of education seem to have persisted in the context of ongoing socioeconomic deprivation and disparities, resulting in high rates of functional illiteracy (Burman & Reynolds, 1986; Molteno, 1985; O'Gorman, 2007; Sonn & Collett, 2010). The introduction of a new curriculum (outcomes-based education) since democratization has not reduced the disparities in education output (Botha & Hite, 2000). These collective factors are purported to partially explain the cross-racial/linguistic/cultural differentials exhibited in cognitive test performances in South Africans (Foxcroft, 2002, 2004; Foxcroft & Roodt, 2005; Jinabhai et al., 2004; Nell, 2000; Thomas, 2010).

1.7.7.3. Socioeconomic deprivation

The inter-racial socioeconomic differences established during Apartheid seem to have persisted after democratization. Intra-racial discrepancies have also emerged, demonstrating extreme differences in financial status and potential for upward mobility. The highest intra-racial differences, (i.e., differences between the wealthy and the poor within each racial group, as measured by the Gini coefficient) are observable between blacks (0.63), followed by coloureds (0.59), Indians/Asians (0.57) and whites (0.56; Monteiro, 2008; Urbach, 2007).

Socioeconomic deprivation has been widely demonstrated to have a negative impact on cognitive development in general (Bergen, 2008; Kaplan et al., 2001; S. Lee, Kawachi, Berkman, & Grodstein, 2003). Language development appears to be particularly vulnerable to socioeconomic deprivation. Children from impoverished backgrounds tend to use fewer abstractions, be less expressive verbally, use more non-verbal communication, and have less complex sentence structures (Feagans, 1982). Reading ability is affected by low parental literacy levels and lack of access to reading material (Bramao, Mendonca, Faisca, Petersson, & Reis, 2007; Braze, Tabor, Shankweiler, & Mencl, 2007). These factors contribute to difficulties in consolidating basic skills such as reading and counting (Alcock, Ngorosho, Deus, & Jukes, 2010), and affect not only language skills, but also nonverbal cognitive skills, for example, visuo-motor performance (Bramao, Mendonca, Faisca, Petersson, & Reis, 2007), specifically drawing and construction tasks (Beery, 1982; Feagans, 1982; Hemp, 1989).

Molteno (1985) outlined the impact of these factors in disadvantaged children in the Western Cape, who demonstrated developmental lags of 2.5 years at pre-primary school level. Throughout the world (e.g., North and South America, Germany, China, Zambia, Cameroon and Senegal), poor language and reading are strong predictors of inferior educational and economic outcomes (Manly et al., 2004; Segerer et al., 2010; Shu, 2010; Wagner, 2010).

1.7.7.4. Group attitudes to psychometric testing

Prior to democratization, psychometric tests were used primarily to assess educability at school level, and trainability in industrial settings (Claassen, 1998). Anti-test lobbyists resisted the use of psychometry, which was viewed as a mechanism to justify Apartheid ideology, and to perpetuate racial prejudice (C. D. Foxcroft, 1997). Despite resistance to testing, however, the need for assessment procedures in educational, industrial, medical, and legal settings persisted. Foxcroft (1997) suggests that the anti-testing phase was beneficial in that it heightened awareness and recognition of the need for the development of less biased instruments, the adaptation of existing measures, and the creation of appropriately stratified normative data.

1.7.7.5. Language issues

Cross-lingual comparisons of cognitive performance are complicated by the different linguistic systems in South Africa. I focus here on the predominant languages (as defined by the latest census data) in the Western Cape province, which are Afrikaans (spoken as a home language by 55% of the province's residents), Xhosa (24%), and English (19%; Statistics South Africa, 2001).

1.7.7.5.1. Language and code mixing and switching

Afrikaans and Xhosa are evolving languages, undergoing modification to lexicons and morphology due to migration, urbanization, and integration with other languages and cultures. The majority of Afrikaans-speakers are also proficient in English, which is regarded as the language of upward mobility, and the language in which most media are presented (Van Dulm, 2007). Many English words have been integrated into the other languages, resulting in particularly high levels of code mixing and code switching, that is, inserting borrowed words, sentences or phrases into the language being spoken (Southwood & Van Dulm, 2009; Van Dulm, 2007; Van Dulm & Southwood, 2008). For Afrikaans- and Xhosa-speakers, it is thus important to present test material in more than one language, and to accommodate language mixing into the scoring rubrics.

Bilingualism and multilingualism can complicate the development of literacy. International research has shown that children who learn English as a second language experience difficulties with spelling, phonological processing, reading accuracy, and word decoding in both languages (Joshi, 2010; Kaani, 2010; Zainab, Joshi, Carreker, & Smith, 2010). Research on bi- and multilingualism is generally conducted on participants who attain proficiency in more than one language.

In many mixed cultures, it may be necessary to examine the effects of language mixing rather than bi-/multilingualism. Internationally, hybrid language systems such as "Spanglish" and "Hmonglish" seem to be developing. It is possible that in these situations, neither English nor the other language (in these examples, Spanish and Hmong) are developed adequately to a level of proficiency seen in bilinguals (Schuler, 2010; Strutt, 2010). This phenomenon is also informally observable in South Africa, particularly in the Western Cape coloured population, who seem to use a unique blend of English and Afrikaans (sometimes nicknamed "Kaaps"), which is different from the type of Afrikaans language used by, for example, white Afrikaans-speakers (Southwood & Van Dulm, 2009; Van Dulm & Southwood, 2008).

Elkonin et al. (2005) recommend the careful scrutiny of material for subtle linguistic idiosyncracies, even in shared languages. Examples of commonly used English words which differ cross-culturally between South Africans and Americans are common (e.g., car boot/trunk; tomato sauce/ketchup; pavement/sidewalk; and biscuits/cookies).

1.7.7.5.2. Testers' language proficiency, cultural familiarity, and qualifications

Testers need to be proficient in (or at least familiar with) English and Afrikaans (when testing Afrikaans-speaking participants) and in all three languages (when testing Xhosa-speakers, who tend to code-switch between all three languages). There are also distinct differences in the formal and informal styles in Afrikaans and Xhosa (Southwood & Van Dulm, 2009). It is preferable to use local testers who are familiar with the dialects, local pronunciation and language styles (including speed and intonation) of the test community (Cofresi & Gorman, 2004).

It is challenging to find qualified practitioners who also satisfy these language credentials, and many testing situations need to adopt pragmatic and flexible approaches. A degree of caution is indicated when interpreting findings when there are language and dialect differences between testers and participants. For example, it is unlikely that a first-language Dutch-speaking examiner testing first-language Shona-speaking Zimbabwean children in their second language (English) will not have some impact on verbal measures of cognitive performance (van de Vijver, 2008) .

Based on their extensive research in the Spanish-English bilingual Latino population, Cofresi and Gorman (2004, p. 111) suggest that "clinicians who speak both languages and are sensitive to the cultural context underlying the client's use of each language have the greatest likelihood of accomplishing a successful and accurate assessment". However, the ratio of trained psychologists/psychometrists to participants needing to be assessed is often disproportionate. Throughout the world, it is necessary for practitioners to test participants from unfamiliar cultural and language backgrounds (Brickman et al., 2006; Carter et al., 2005).

In the United States, for example, assessments are required for Asian Americans from a wide range of national and cultural/ethnic origins, for example Chinese, Filipino, Vietnamese (Khmer, Laotian, and Hmong), Korean, and Japanese (Wong & Fujii, 2004). Even clinicians who adopt the most diligent anthropological-consultative approaches are hard-pressed to assess immigrant populations from widely divergent origins (e.g., Hmong, Laotian, Karen, Somali, Ethiopian and Bosnian), with differing levels of English competence. Schuler (2010), for example, recognizes that it would be almost impossible to collect norms appropriate for every type of cultural group, and compensates by collecting and recording data based on his assessments. In this way, pockets of norms with small sample sizes may be preferable to large-scale published norms collected from samples representing the dominant cultural groups.

Such situations highlight the ethical dilemma of how to meet professional and linguistic requirements in real-world situations. Drennan and Swartz (2002) highlight the inequities in health science settings in South Africa, where, aside from nurses, there is an imbalance between healthcare providers who speak languages other than English and Afrikaans, and the recipients of their care, who speak other languages. The use of interpreters is an option which is not without problems. For example, interpreters are not usually familiar with testing techniques or materials, and have been found to distort participants' responses by, for example, making unsolicited corrections to participant answers or assisting the participants (Brickman et al., 2006; Drennan & Swartz, 2002; Schuler, 2010; Strutt, 2010).

Authors specializing in cross-cultural testing recommend that testers attempt some degree of investment in trying to understand the cultural practices of intended participants. Some suggest full immersion or formal anthropological studies of the test community (e.g., Wong & Fujii, 2004). Others adopt a more pragmatic consultative approach, where representatives of the local community are consulted regarding the relative appropriateness of test materials and philosophies (e.g., C. D. Foxcroft, 2002). I adopted a consultative approach (adapting test material in collaboration with academic linguists and community representatives).

In line with other South African universities (Shuttleworth-Edwards et al., in press; Thomas, 2010), I also employed post-graduate students in psychology, who were from the local community and proficient in the relevant test languages, to administer the tests under the supervision of a licensed clinical psychologist. The use of graduate students under supervision is widely practiced in large standardization studies, for example that of the WASI (Psychological Corporation, 1999). This approach simultaneously solves the problem of language differences, contributes to the education and training of professionals sensitive to cross-cultural issues, and facilitates the collection of local normative data bases.

1.7.7.5.3. Translation problems

Research in the Spanish-speaking population in the USA (I Fortuny et al., 2005; Strutt, 2010), and in Xhosa-English translations in South Africa (Drennan & Swartz, 2002), have provided examples of substantial distortions of meaning resulting from inexact translations and interpreter-related variations. Preparation of test material to reduce test bias thus requires more than simple translation, due to the different language structures, ambiguities in meaning, and idiomatic and accentuation differences (Ardila, 1995; Kanjee, 2005; T. M. Wong & Fujii, 2004). At the very least, translation needs to involve Brislin's (1983) three steps: 1) translation; 2) back-translation; and 3) resolving differences between the original and translated versions.

Translation from English into the other languages used in the Western Cape is complicated by the different language structures. Xhosa is an agglutinating language where elements are compounded into words (e.g., *ndiyakuthanda* is one word which means *I love you*). It is also a tonal language, which means that, depending on the tonal pattern used, one word can have different meanings (e.g., *ithanga* can mean *thigh*, *pumpkin,* or *cattle outpost*) (e.g., *ithanda* can mean *thigh*, *pumpkin*, or *cattle outpost*; Du Plessis & Visser, 1998). Although I do not report data on Xhosa-speakers in this dissertation, consideration of these complexities was important for adaptation of tests which would allow for future testing in Xhosa as well. Xhosa is one on the Nguni languages (Southern Bantu language family), and is similar to Ndebele, Swati, and Zulu (Reader's Digest, 1991), implying that test adaptation principles may be transferable between these languages.

The principles of grammatical structure for English and Xhosa differ from those for Afrikaans. In the former languages, the finite verb is placed after the subject, but in Afrikaans, it is positioned at the end of the sentence (Conradie, 2005). Afrikaans, which is of Hollandic Dutch origin, is more proximal to Dutch, German, and Flemish than to English (Van Dulm & Southwood, 2008). Accessing adapted test material in these European languages is potentially useful for Afrikaans studies. For example, it was useful to use guidelines established in a Dutch normative study regarding the suitability of 9 different letters for evaluating phonemic fluency (Van den Dungen & Groenink, 2004).

1.7.8. Interactions between race, language, and quality of education

The work of Manly and colleagues in the United States has demonstrated that racial differences in cognitive test results are strongly attenuated by higher levels of, and better quality of, education (Cosentino, Manly, & Mungas, 2008; Manly et al., 2004; Manly & Echemendia, 2007; Manly et al., 1999; Manly, Jacobs, Touradji, Small, & Stern, 2002). Because, as Grieve (2005, p. 230) explains, “formal education provides us with the problem-solving strategies, cognitive skills, and knowledge that we need to acquire information and deal with new problems”, the effects of a previously segregated education system are likely to impact on cognitive test performance. Consequently, it is vital to investigate and control for the interaction between race and both level and quality of education when comparing cognitive performance across race (Nell, 1999).

The work of Shuttleworth-Edwards and colleagues (e.g., Shuttleworth-Edwards, Donnelly et al., 2004; Shuttleworth-Edwards, Kemp et al., 2004; Shuttleworth-Jordan, 1996) has set a precedent with regard to examining the interactions between race, language, and quality of education in heterogeneous populations. This research group has, for example, investigated these multifactorial influences on the outcomes of intelligence testing in multiracial and multilingual young adults (WAIS-III) and in adolescents (WISC-IV).

Their data demonstrated that increased level of education and better quality of education were both associated with higher full-scale IQ scores on the WAIS-III (Shuttleworth-Edwards, Kemp et al., 2004). The scores of white English first-language participants as well as black African first-language (incorporating a mixture of South African indigenous languages) participants with advantaged education were commensurate with the USA norms, but black African-language participants with disadvantaged education achieved substantially lower scores than participants in both other groups, and in comparison with the USA norms. The effect of quality of education was more pervasive than level of education within the black African-language groups: disadvantaged quality of education resulted in lowered scores on all subtest, index, and IQ scores, but five of the measures were not adversely affected by lower level of education. Shuttleworth-Edwards et al.’s (in press) WISC-IV study yielded a continuum of results, from highest to lowest ranges of IQ and subtest scores, as follows: 1) white-English-advantaged; 2) white–Afrikaans-advantaged, which was equal to black-Xhosa-advantaged; 3) coloured-Afrikaans-advantaged; 4) black-Xhosa-disadvantaged; 5) and coloured-Afrikaans-disadvantaged. The lowering of scores was most profound and clinically significant in the disadvantaged group (i.e., IQ scores up to 2 SDs lower than UK standardization norms).

Other South African studies have revealed similar trends of lowered scores on a range of cognitive tests by participants with disadvantaged quality of education, both within and between racial-linguistic groupings, and in comparison to non-local norms from the UK or the

US (e.g., Cavé & Grieve, 2009; Grieve & Viljoen, 2000a; Jansen & Greenop, 2008a; Jinabhai et al., 2004; Skuy et al., 2001; Skuy et al., 2000).

1.7.8.1. Operationalization of quality of education

Although there is no doubt that stratification of norms by quality of education in multilingual, multiracial populations is useful, the process of quantifying quality of education is complex and inexact (Jinabhai et al., 2004). Manly et al. (e.g., 2002)used reading level (which was lower in African-Americans educated in segregated schools) as a proxy for quality of education. South African researchers have used a more direct approach, similar to Shuttleworth-Edwards (e.g., in press), by the dichotomous categorization of quality of education in two groups based on formerly segregated education systems. For example, white learners attended private schools (based on British education systems) or well-resourced government (model C) schools. Black and coloured learners were educated under the parliamentary divisions of the Department of Education and Training (DET), and the House of Representatives (HOR), respectively.

Because of the discrepant allocation of human and material resources in favour of white education systems, wide disparities in quality of education were entrenched during the Apartheid era, with black and coloured learners denied access to the better-resourced schools. Since democratization, socioeconomically advantaged black and coloured learners have had access to better educational facilities (including private schooling), but previous inequities between quality of education in formerly disadvantaged schools tends to have remained, or have been exacerbated since desegregation (Shuttleworth-Edwards, Kemp et al., 2004; Shuttleworth-Edwards et al., in press).

Some researchers have based their investigations at only one or at a few schools. Within the selected schools, they have supplemented quantitative data (i.e., categorization into two groups with differing quality of education) with qualitative descriptions. These descriptions are typically based on information gathered from actual site inspections of the schools, and serve to confirm that the quantitative categorizations matched the observed characteristics of the schools (e.g., Cavé & Grieve, 2009). Other researchers have recruited participants from multiple schools, and have then defined quality of education in terms of former education system nomenclature without evaluating possible differences between schools thus classified as *disadvantaged* (e.g., 2001).

So, in studies that draw samples from many schools, the quality of education of each school is not typically evaluated in any sort of depth. My study follows this precedent; that is, I assume that quality of education is poorer due to previous disadvantage, and due to location in currently economically poorer communities (Jinabhai et al., 2004; Skuy et al., 2001). It is acknowledged that quality of education might better be described as a spectrum rather than as a dichotomous category, and that variations in numerous factors might contribute to where a particular school is placed on that spectrum. Such factors include the school environment (e.g., maintenance of facilities, safety, location in areas affected by gang culture); human resources (e.g., learner-educator ratios, qualifications, language proficiency, and absenteeism rates of educators); material resources (e.g., access to electricity, books, computers, libraries, science laboratories and materials, furniture in working condition, and teacher aids such as chalk boards and overhead projectors); ethos (e.g., attitudes to discipline, classroom management style); and community support (e.g., parental involvement, assistance by community organizations).

1.8. Norms

1.8.1. Why norms are necessary

An individual's raw test score is meaningless in isolation. Useful inferences about what the raw score indicates can only be made by evaluating it in relation to other information (Lezak et al., 2004; Mitrushina et al., 2005; Strauss et al., 2006). Raw scores may be compared to the individual's own performance on the same test on previous occasions (i.e., the *ipsative* approach), or by comparing the individual's performance to the performance of a demographically similar peer group on the same test (i.e., the *norm-referenced* approach; Huysamen, 2002; Mitrushina et al., 2005). The ipsative approach is not commonly used for diagnostic purposes, but it is useful to track the individual's progress (or deterioration) over time, or to track the effects of medication (Llorente et al., 2003).

The norm-referenced approach is useful for diagnostic and descriptive purposes. Although there are terminological anomalies in the literature, I use the term *norms* to refer to normative data collected from healthy or typically developing individuals. In contrast, I use the term *abnorms,* originated by Mitrushina et al. (2005) to refer to reference data collected from clinical samples (i.e., those with diagnosable neurological conditions). Norms and abnorms provide information to assist clinicians in interpreting an individual's test performances in a way that allows them to contextualize and characterize cognitive functioning meaningfully and to make diagnostic inferences accurately (Mitrushina et al., 2005).

1.8.2. How norms are established

Norms are constructed by testing large numbers of healthy individuals to determine a range of typical functioning on a particular domain or test, within a relatively homogenous population. The raw scores are usually linearly transformed into some type of standardized score. This transformation allows for the same functional unit to be used in comparisons, either between the individual and others, or between different aspects of an individual's performance (Mitrushina et al., 2005; Strauss et al., 2006).

1.8.2.1. Transformed scores

Various types of transformed scores are used in psychometric testing. *Percentiles* are widely used, and indicate the individual's relative standing in the peer group, e.g., a percentile rank of 20 means that the individual performed equal to or better than 20% of the population, but equal to or worse than 80% of the population (Mitrushina et al., 2005; Strauss et al., 2006). *Z-scores* are calculated by subtracting the mean sample score from the individual's score, then dividing by the sample standard deviation (SD). *Z*-scores (mean = 0, SD = 1) are frequently used in psychometric research. Other popular measures include *T-scores* (mean = 50; SD = 10); *scaled scores* (mean = 10; SD = 3), and *index scores* or "IQ" deviation scores (mean = 100, SD = 15), which are typically used in the Wechsler scoring systems.

1.8.2.2. Standard normal distribution

Measurement in the human sciences makes use of the *standard normal distribution*. This term refers to a bell-shaped frequency distribution, which facilitates the estimation of the proportion of scores that fall within a given interval under the curve (Strauss et al., 2006). Figure 1 shows that 68% of scores are likely to fall within 1 SD above or below the mean; 95% within 2 SDs and 99.7% within 3 SDs from the mean. From this distribution, it is possible to deduce the extent to which an individual or group score deviates from standard normal expectations (Psychological Corporation, 1999; Strauss et al., 2006). The figure also demonstrates the relative standing of other types of standardized scores, in terms of standard deviations from the means. Consequently, clinicians are able to use different types of transformed scores to establish the individual's position in relation to the standardization sample.

Sometimes scores are not normally distributed, i.e., they are positively or negatively skewed. For example, vocabulary scores for a sample of postgraduate linguistics students are likely to accumulate to the right side of the curve, resulting in a *negatively skewed* distribution. In contrast, the distribution of data from the same task administered in English to Afrikaans-speaking 6-year olds is likely to be *positively skewed* (clustered to the left of the curve). In these examples, the vocabulary test would be described as having a *low ceiling* for the students and a *high floor* for the children (Strauss et al., 2006). Whether or not this pattern of data is problematic depends on the purpose of the test. If the test is used to identify children needing language remediation, for example, the data would be misleading. There are various alternative methods to interpret test data based on skewed distributions, which are beyond the scope of this dissertation but which are described in various texts (Lezak et al., 2004; Mitrushina et al., 2005; Strauss et al., 2006).

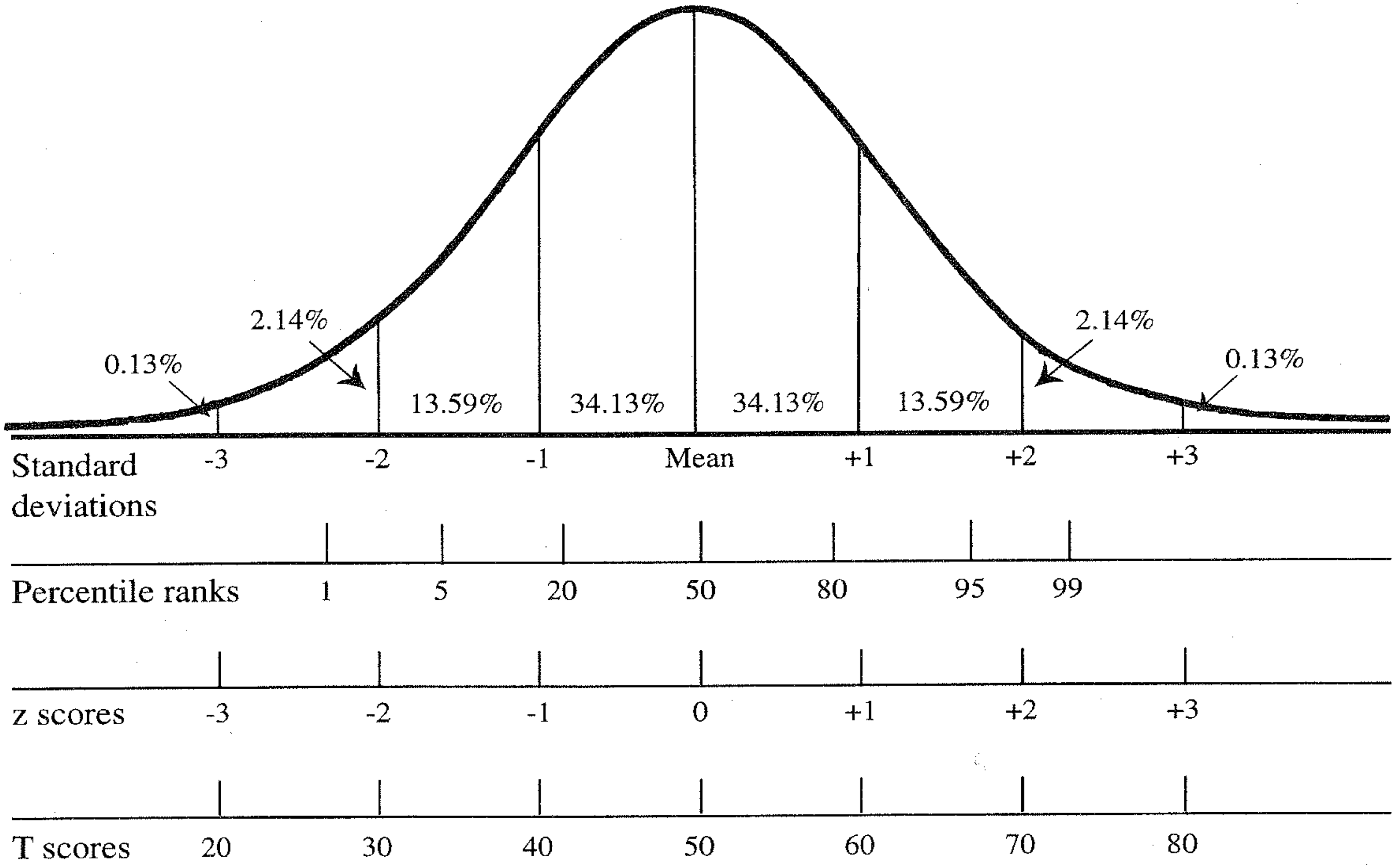

Figure 1. Percentages of scores in the standard normal distribution in relation to percentile ranks, *z*-scores, and *T*-scores. (Reproduced from Mitrushina et al., 2005, Figure 3.1., p. 37).

1.8.3. Issues complicating norm-referenced cognitive evaluation

1.8.3.1. Cutoff scores and the potential for misclassification

In interpreting cognitive test scores, the most commonly used method to determine functional impairment or the presence of a neuropathological condition is to use cutoff scores (Heaton, Grant, & Matthews, 1992; Heaton, Miller, Taylor, & Grant, 2004). Ideally, scores below identified cutoff points indicate genuine impairment due to cerebral damage or inherent low ability (Shuttleworth-Jordan, 1997; Strauss et al., 2006). In practice, however, determination of cutoff scores can have marked effects on the sensitivity and specificity of impairments. *True positives* are those who are genuinely impaired and warrant a specific diagnosis, and *true negatives* are those whose functioning is insufficiently impaired to be diagnosable as pathological.

Cutoff bands or ranges are generally preferable to single cutoff points (Wolfaardt & Roos, 2005). Cutoff points or bands are, however, not always set at the correct level. It is necessary to establish whether or not cutoffs derived from borrowed norms are appropriate for local samples (Elkonin et al., 2005). Cutoffs that are too stringent generate *false positives*, that is, participants are incorrectly classified as impaired or as having a diagnosis which is actually absent. Conversely, cutoffs that are too lenient generate *false negatives*, that is, diagnoses or impairments that actually exist are not correctly acknowledged or classified (Mitrushina et al., 2005; Shuttleworth-Jordan, 1997).

Both types of misclassification have serious consequences, in the form of unnecessary financial and emotional burdens in patients, and ethical, professional, and legal complications for practitioners (Bauer, 1997; de Rotrou et al., 2005; Farah, 2007; Lezak et al., 2004; Martin, Allan, & Allan, 2008; Mitrushina et al., 2005; Nell, 2000; Strauss et al., 2006; T. M. Wong, 2006). False negatives carry the obvious consequences of legitimately disabled individuals not receiving remediation or compensation. In South Africa, there is a risk of not detecting real impairment because poor performance is assumed to be a consequence of socioeducational deprivation (C. D. Foxcroft, 1997; Shuttleworth-Jordan, 1996). False positives can be burdensome to the insurance industry, but also to patients, who believe their conditions and prognoses to be worse than they actually are, and who may invest considerable energy and money into unnecessary treatments (Bauer, 1997).

1.8.3.2. Interpretive categories

In order to enhance the utility of cutoff scores, various interpretive classification systems have been developed. Heaton et al. (2004), for example, devised an interpretive system for classifying performance at seven different levels, ranging from above average to severely impaired. Such interpretive categories have been helpful in differentiating between different levels of performance, but do not guarantee that individuals won't be misclassified (Lezak et al., 2004; Strauss et al., 2006). Bornstein et al. (1987), for example, found that Heaton et al.'s (1986) cutoff norms for the GPT resulted in high false positive classification rates in normal participants, but negligible misclassifications in brain-injured patients. Conversely, Bornstein et al.'s (1987) adjusted impairment cutoffs for the GPT resulted in fewer misclassifications of normal participants, but more false negative classifications in patients (i.e., greater sensitivity but lower specificity).

It is also important to recognize that some typically developing or healthy individuals perform poorly on cognitive measures, and that establishing base rates of below-average performance is a useful adjunct to cutoff scores (Brooks & Iverson, 2010; Iverson, Brooks, & Holdnack, 2008). For example, Brooks et al. (2009) demonstrated that low scores in the CMS are relatively common in children and adolescents, particularly in those with lower intelligence. Specifically, 33.3% of children with below average intelligence had one or more memory index scores below the 5th percentile, compared to 3.5% in children with above-average intelligence.

1.8.3.3. Standardization process problems

The quality of norms is dependent, to a large extent, on the empirical soundness of the standardization studies from which they are collected. Factors that compromise the scientific credibility of standardization processes include irregularities and inconsistencies in test administration and scoring procedures (Mitrushina et al., 2005; Strauss et al., 2006).

Inadequate screening procedures also undermine the capacity for norms to reflect normal test performance. To characterize normal performance adequately, it is important to exclude participants with current or past pathology that may impact on their ability to perform cognitive tasks normally. Although self-reported screening methods are considered to be adequate, those involving medical or neuroimaging evaluation are preferable (Mitrushina et al., 2005). Norms derived from hospitalized patients (medical or psychiatric) introduce elements of ambiguity. It is questionable whether their cognitive functioning can be considered as normal due to their medical conditions and the possible side effects of medication (Mitrushina et al., 2005).

1.8.3.4. The Flynn effect and the importance of current norms

The *Flynn effect* refers to the tendency for cognitive scores to improve over time. This pattern of upward drift was initially observed in intelligence scores, which reportedly increased at the rate of 0.3 IQ points per year, or 3 to 6 IQ points per decade, depending on the tests used (Flynn, 1985, 1998). The magnitude of the increase is twice as large in tests of fluid intelligence compared to crystallized intelligence (Lezak et al., 2004).

This tendency has also been observed in other domains such as executive functioning, and in other tests, for example, Trail Making Tests and Symbol Digit Modalities Tests, which increased at the rate of 6 “IQ” points in a decade (Dickinson & Hiscock, 2011). The Flynn effect has been widely demonstrated in industrialized countries, and also in developing countries. For example, large gains were observed in Raven’s Progressive Matrices scores over a 14-year period in two rural communities in Kenya (Daley, Whaley, Sigman, Espinosa, & Neumann, 2003).

Nell (1994) explains that older norms fail to reflect the ongoing educational and experiential development of the age cohorts and are more likely to inflate abilities in participants tested long after the norms were collected. The factors contributing to the Flynn effect are still debatable (e.g., more culture-fair testing, evolution of problem-solving skills, or the accumulation of knowledge). The implications for cognitive testing, however, are clearer: outdated norms carry a high risk of being misleading, and norms need to be updated at least every decade (Foxcroft, 2004; Mitrushina et al., 2005; Nell, 1997).

1.8.3.5. Norm selection criteria

Mitrushina et al. (2005) provide a compendium of critically evaluated norms and meta-norms for several commonly-used tests, and suggest that no ideal normative data exist, as norms are always heavily influenced by context. They suggest that, as a rule of thumb, the best norms to use are those that provide the best goodness-of-fit between the individual or group being assessed, on the one hand, and the demographic characteristics of the reference group, on the other.

In situations where the standardization norms are not suited to the profile of the test population, clinicians are faced with predicaments regarding which norms to use as a source of reference. To complicate this problem, existing norms are not always accessible. For example, they may be difficult to locate because they are embedded within clinical studies (Mitrushina et al., 2005). Similarly, local data that have been collected for postgraduate theses, for example, may be difficult and expensive to access because they are unpublished, or unavailable on electronic databases. Furthermore, in situations where more than one set of appropriate norms is available, normative information may provide contradictory information, leaving the investigator unsure which set to trust (Mitrushina et al., 2005; Strauss et al., 2006).

Mitrushina et al. (2005) provide the following general guidelines for selecting norms: 1) if multiple norms are available, read the critical reviews; 2) if multiple norms have contradictory values, consult the meta-norms; 3) if no norms exist, use the meta norms (but interpret results with caution because the expected values are extrapolated from regression equations); 4) use actual norms in preference to meta-norms; and 5) if possible, use the most recent norms.

Mitrushina et al. (2005) also set specific suitability criteria to evaluate norms: 1) sample size should be at least 50; 2) sample characteristics should be adequately described (e.g., exclusion criteria, geographic location, ethnicity, education level, IQ, and handedness); 3) age bands should not be too large; 4) test versions, stimuli and administration details should be precisely specified; and 5) means, standard deviations and score ranges should be reported.

1.8.3.6. Norm selection difficulties: a practical example

As an example of the practical difficulties in selecting appropriate pre-existing norms, I illustrate how pre-existing norms for the GPT were all problematic for use within my study population:

- There are few norms for participants with fewer than 12 years of formal education (Mitrushina et al., 2005).
- Norms that do exist for samples younger than 18 are outdated in that the data were collected over 3 decades ago (Knights, 1970; Knights & Moule, 1968; Trites, 1977), and typically have small cell sizes (Campbell, Brown, Cavanagh, Vess, & Segall, 2008).
- Some age-appropriate norms, for example those by Trites (1977), were based on scoring conventions that are not currently used (i.e., a total score including time, drops, and number of pegs inserted), although derived scores which reflect only the time to completion are available.
- Only 2 of the 16 GPT studies conducted between 1985 and 1999 and reviewed in Mitrushina et al. (2005) have data applicable to adolescents and to participants with fewer than 12 years of education (i.e., Heaton et al., 1986; Ruff & Parker, 1993). Both

of those studies, however, are based on American samples that are predominantly white and English-speaking.

- Strauss et al. (2006) cite norms for Canadian adolescents aged between 12 and 15, based on personal communication with the authors (Paniak, Miller, & Murphy, 2004), but these have not been published.
- Some norms are available for participants from cultural backgrounds that differ from the standardization populations and who use languages other than English. Examples include norms for Spanish-speaking children resident in the USA (Rosselli, Ardila, Bateman, & Guzman, 2001); African children from the Democratic Republic of Congo (Kashala, Elgen, Sommerfelt, Tylleskar, & Lundervold, 2005); and young adults in Uganda (Robertson et al., 2007). There is, however, no evidence that these norms are transferable to other languages or cultural contexts.
- Although Meyer and Sagvolden (Meyer & Sagvolden, 2006) conducted a South African study comparing GPT performance in children with or without ADHD in 7 language groups (viz., Northern Sotho, Venda, Tsonga, Tswana, North Ndebele, Bolobedu, and Afrikaans), the norms for the control group were not tabulated or cited in the publication.

1.9. South African normative studies

Summaries of locally developed or non-local adapted/unadapted tests that were normed before 2000 are provided in South African texts, for example, by Claassen (1998), Owen and Taljaard (1996), and Nell (2000). Table 1 provides a summary of some of the South African normative studies that have been published in the last decade. This summary provides a clear, though not exhaustive, indication of research trends after constitutional changes were propagated to reduce unfair and biased testing in South Africa. A more detailed review of these trends follows.

1.9.1. Summary of research trends

1.9.1.1. Test selection

All but one of the 11 studies (Boon & Steel, 2005) focused on non-local instruments developed in the USA and the UK. Only one study focused on computerized tests (Grieve & Viljoen, 2000) rather than traditional paper-and-pencil cognitive tests. The majority of tests (8 of the 11) were individually administered; three were group-administered (Boon & Steel, 2005; Jinabhai et al., 2004; Knoetze et al., 2005). Most test batteries incorporated an IQ component, mostly in the format of a Wechsler scale or Raven’s Matrices (Jansen & Greenop, 2008). Only two studies did not incorporate a measure of intelligence (Boon & Steel, 2005; Cavé & Grieve, 2009). The scope of cognitive domains was least frequently (2 of the 11) unidimensional, measuring a single domain in one stand-alone test (Boon & Steel, 2005; Knoetze et al., 2005). Most studies measured multiple domains, via standardized batteries (5/11) or eclectic test collections (4/11).

1.9.1.2. Sampling characteristics

Sample size: Mitrushina et al.'s (2005)recommended minimal sample size of 50 was not attained in two of the studies (Cavé & Grieve, 2009; Grieve & Viljoen, 2000). Although seven of the studies met Mitrushina et al.'s criteria, the sample sizes were below Foxcroft's (C. D. Foxcroft, 2005) recommendation of between 400 and 500 for normative studies, and in two studies, the size of heterogeneous comparison groups was small (i.e., n = 9 to 28) (Shuttleworth-Edwards, Kemp et al., 2004; Shuttleworth-Edwards et al., in press). Only two studies (Claassen et al., 2001; Jinabhai et al., 2004) exceeded Foxcroft's recommended sample sizes.

Age range: Studies of children, adolescents, adults, and mixed age ranges were evenly distributed. Two studies focused exclusively on a restricted adolescent age-group of young adolescents (12 to 13 years; Shuttleworth-Edwards, Kemp et al., 2004), and older adolescents (17 years; Cavé & Grieve, 2009).

Race: More than half of the studies (6/11) included only black participants; two studies included black and white participants (Cavé & Grieve, 2009; Shuttleworth-Edwards, Kemp et al., 2004); and coloured participants were included in only three of the studies (Claassen et al., 2001; Grieve & van Eeden, 2010; Shuttleworth-Edwards et al., in press).

Geographical region: Most studies (8/11) were conducted in urban areas with urbanized samples, with one rural (Jinabhai et al., 2004), and one peri-urban (Grieve & Viljoen, 2000) study location. There was one national study (Claassen et al., 2001) and one study involving sites in two provinces (Grieve & van Eeden, 2010). Most studies were located in the Eastern Cape and Gauteng (7/11), with single studies being based in KwaZulu Natal (Jinabhai et al., 2004) and in the Western Cape (Boon & Steel, 2005).

Quality of education and norm stratification: There seemed to be an increased awareness of the need for norms for the population who received disadvantaged quality of education (6/11) and for differentiating between participants with different quality of education (4/11). Quality of education was not reported in a single study (Claassen et al., 2001). None of the studies were conducted exclusively on participants with advantaged quality of education. With one notable exception (Claassen et al., 2001), the studies were appropriately stratified for relevant constant and changeable cultural variables.

An interim National Community Survey conducted in 2007 (Statistics South Africa, 2007) shows that the racial breakdown in the Western Cape province differs substantially from the national profile (cited in parenthesis). Coloureds comprise 50% (compared to 9%) of the provincial population, blacks comprise 30% (versus 79%), whites comprise 21% (versus 10%) and Asians comprise 1% (versus 3%). Normative studies in the Western Cape should thus cater for coloured Afrikaans- and English-speakers; black Xhosa- and English-speakers; and white Afrikaans- and English-speakers. Clearly, the demand exceeds the availability of normative data for cognitive tests presently available for the population of the Western Cape.

Although my study is limited in that it does not include Xhosa-speakers, it does contribute to the paucity of updated norms for urbanized coloured and white adolescents resident in the Western Cape, and sets up a methodological template for the replication of the adaptation and administration processes to other language groups. Although the sample size is approximately half of Foxcroft's (2005) recommendation, it is four times higher than Mitrushina's (2005) acceptable size. Within a restricted, but developmentally active age range, this study provides appropriately stratified norms (i.e., by age, race, language, and quality of education, depending on the relative contribution to test performance made by each factor).

1.9.1.3. Screening methodology and exclusionary criteria

Studies using group-administered tests tended to do cluster sampling (e.g., whole schools or whole classes), which allowed for the time-efficient collection of norms with large sample sizes. On the other hand, in some studies, exclusionary criteria were not employed (e.g., Boon & Steel, 2005; Knoetze et al., 2005). Although this is understandable from an ethical perspective (i.e., to allow all members of a class to be tested), it is problematic. Because no screening procedures were used in these studies, there was no control for neuropathological confounds, thus it is likely that the purity of a "normative" sample was compromised. If simple screening procedures had been employed (e.g., parental history-taking questionnaires), the "normal" sample could have been controlled. Furthermore, identification of children with previous head injuries or ADHD, for example, could have provided a useful opportunity to collect “abnorms”.

Screening methodology in the studies ranged from lenient to stringent, with examples of studies where neither screening methods nor exclusionary criteria were reported (Jansen & Greenop, 2008; Knoetze et al., 2005); partially reported, in that exclusionary criteria were named, but screening methods were not reported (Grieve & van Eeden, 2010; Grieve & Viljoen, 2000); exclusionary criteria were reported, and participants were screened via parental or self-reported questionnaires (Cavé & Grieve, 2009); or exclusionary criteria were reported and participants were screened by clinical/medical evaluation (Jinabhai et al., 2004).

The absence of screening is particularly noteworthy in the study by Knoetze et al. (2005) in that the age range of primary school learners was 7 to 20 years. Although it is fairly typical to have a wide age range within education bands in South Africa, the extent of disparity in this primary school was extensive. Because participants were not screened for repeated school grades, there seems to be an increased possibility that a percentage of the older participants may have been cognitively impaired. As mentioned previously, inclusion of impaired participants in a norming study is ill-advised, as it seriously compromises the characterization of *normal* cognitive functioning (Mitrushina et al., 2005; Strauss et al., 2006).

In my study, participants were formally screened via clinical interview, and strict exclusionary criteria were applied. There is therefore a strong likelihood that norms from my study sample adequately characterize *typical* cognitive functioning within the particular sociodemographic profile on which I focused.

1.9.1.4. Language heterogeneity

Language of administration: In half of the studies, participants were tested in English, despite the fact that this language differed from their home language. Interpreters were employed in two studies: in one of those studies test material was informally orally translated into Zulu (Jinabhai et al., 2004), and in the other it was informally translated into Xhosa (Shuttleworth-Edwards et al., in press). Written translations were used in Afrikaans (Grieve & van Eeden, 2010; Shuttleworth-Edwards et al., in press) and Xhosa (Boon & Steel, 2005; Knoetze et al., 2005), but no cross-lingual studies examined verbal items for inter-lingual equivalence prior to testing. Particular strengths of my study are that 1) participants were tested in their preferred languages, using formally translated test material; and 2) test material was scrupulously evaluated, including by empirical means, and adapted in an attempt to ensure linguistic equivalence between English and Afrikaans versions, and to reduce the potential for cultural bias.

The 11 studies reviewed in Table 1 demonstrated a trend to cluster polyglot black-language participants into a single-language comparison group because they are tested in English (Cavé & Grieve, 2009; Claassen et al., 2001; Jansen & Greenop, 2008; Shuttleworth-Edwards, Kemp et al., 2004; Skuy et al., 2001). This practice fails to account for potential variations in cognitive test performance that may be associated with inter-lingual differences in, for example, structure and style of language of origin; age of establishing language proficiency; degree of language proficiency in multiple languages; and the extent of code mixing and code switching (as described in section 1.7.7.5). It appears as if language of origin has not enjoyed the same degree of scrutiny and attention afforded to other factors (e.g., race, age, level and quality of education) in South African cross-cultural normative research. A possible starting point for future studies to investigate heterogeneity within polyglot groups may be to cluster participants according to proximal language groupings (e.g., the Nguni cluster, which includes Xhosa, Zulu, Ndebele, and Swati).

Table 1. *Summary of Published South African Normative Studies since 2000, Arranged Chronologically*

Study	Cognitive Test/s	*N*	Age	Language of Test Admini-stration	Group composition and stratification (race-first language-quality of education), and additional stratification (by age, level of education, and sex)	Region
Grieve & Viljoen (2000)	Individual administration of computerized versions of: Austin Maze; Halstead-Reitan Category Test; RSPM	30	19 - 29	English	Black-Venda-disadvantaged, stratified by sex	North-West Province, peri-urban
Claassen et al. (2001)	Individual administration of WAIS-III	900	16 - 34	English	Asian, coloured, black, and white-English, Afrikaans, and polyglot indigenous SA language (quality of education NR), stratified by age	National, urban
Skuy et al. (2001)	Individual administration of: WISC-R; Individual Scales for African Language Speaking children; RAVLT; ROCFT; SCWT; WCST; TMT Spatial Memory Test; Draw-a-Person-Test; Phonemic Fluency	252	12 - 24	English	Black-polyglot indigenous SA language-disadvantaged, stratified by age category	Gauteng, urban
Jinabhai et al. (2004)	Group administration of: RCPM; RAVLT; Symbol Digit Modalities test; Young's Group Mathematics Test	806	8 - 11	Zulu**	Black-Zulu-disadvantaged, stratified by sex	KwaZulu Natal, rural
Shuttleworth-Edwards et al. (2004)	Individual administration of WAIS-III	68	19 - 30	English	1. White-English-advantaged; 2. black-polyglot indigenous SA language-advantaged; 3. black-polyglot indigenous SA language-disadvantaged, stratified by level of education	Eastern Cape, urban
Boon & Steel (2005)	Group administration of Paper and Pencil Games (HSRC test)	177	8 - 16	Xhosa*	Black-Xhosa-disadvantaged	Western Cape, urban
Knoetze, Bass, & Steele (2005)	Group administration of RCPM	379	6 - 11	Xhosa*	Black-Xhosa-disadvantaged; stratified by age, and sex	Eastern Cape, urban
Jansen & Greenop, (2008)	Individual administration of K-ABC excerpts	199	5; 10	NR	Black-polyglot indigenous SA language-disadvantaged, stratified by age, and sex	Gauteng, urban

Study	Cognitive Test/s	*N*	Age	Language of Test Admini-stration	Group composition and stratification (race-first language-quality of education), and additional stratification (by age, level of education, and sex)	Region
Cavé & Grieve, (2009)	Individual administration of: Verbal Fluency Test; Design Fluency Test; SCWT; WCST	40	17	English	1. Black-polyglot indigenous SA language-disadvantaged; 2. white-English and polyglot language-advantaged	Gauteng, urban
Grieve & van Eeden (2010)	Individual administration of WAIS-III (HSRC Afrikaans translation)	82	20 - 25	Afrikaans*	1. White-Afrikaans-advantaged; 2. coloured-Afrikaans-disadvantaged; stratified by region, and sex	1. Gauteng, urban; 2. Western Cape, peri-urban
Shuttleworth-Edwards et al. (in press).	Individual administration of: WISC-IV	69	12 -13	Afrikaans*; English; Xhosa**	1. White-English-advantaged; 2. white-Afrikaans-advantaged; 3. black-Xhosa-advantaged; 4. black-Xhosa-disadvantaged; 5. coloured-Afrikaans-advantaged; 6. coloured-Afrikaans-disadvantaged	Eastern Cape, urban

Note. NR = Not Reported;* = written translation; ** = informal oral translation by interpreter; HSRC = Human Sciences Research Council; KABC = Kaufman Assessment Battery for Children; RAVLT = Rey's Auditory Verbal Learning Test; RCPM = Raven's Coloured Progressive Matrices; ROCFT = Rey-Osterrieth Complex Figure Test; RSPM = Raven's Standard Progressive Matrices; SCWT = Stroop Color-Word Test; TMT = Trail Making Test; WAIS-III = Wechsler Adult Intelligence Scale, 3rd edition; WCST = Wisconsin Card Sorting Test; WISC-IV = Wechsler Intelligence Scale for Children (4th UK Edition); WISC-R = Wechsler Intelligence Scale for Children, Revised Edition.

1.9.2. Lessons learned from South African normative research

1.9.2.1. The South African English standardization of the WAIS-III

The 2001 South African English standardization of the WAIS-III (Claassen et al., 2001) is the only large-scale standardization study conducted in this country in the last decade. The rationale, methodology, and norms for this study have attracted widespread criticism, and have provided South Africans with some ideas about the difficulties inherent in conducting normative studies.

At the time of data collection for that standardization, only 10% of the South African population spoke English as their first language. To try to ensure equal representation of all race groups, the research also included participants who were partially educated in, or who had some social or occupational exposure to, English. Consequently, black Africans were tested in their language of learning rather than in their home language, and Afrikaans-speakers were tested in English, which was neither their home language nor their language of learning (Claassen et al., 2001). Published norms were stratified only by age, ignoring the possible effects of race, language of origin, and quality of education.

In addition to the previously mentioned criticism of Claassen et al.'s (2001) standardization study, numerous other problem areas have been identified in this particular study, for example: 1) equivalence across language groups was not established (C. D. Foxcroft & Aston, 2006); 2) the racially-representative consultation process, or the results thereof, were not published (C. D. Foxcroft & Aston, 2006); 3) some tests which seem culturally loaded (contextually and ideologically), for example the Picture Completion and Picture Arrangement subtests, were neither included in the list of subtests inviting commentary, nor omitted, amended, or replaced (van Ommen, 2005); 4) the few adapted or replaced items were not re-piloted to establish their suitability (C. D. Foxcroft & Aston, 2006); 5) the norms are demonstrably biased against second-language English speakers, specifically black and Afrikaans-speaking participants (C. D. Foxcroft & Aston, 2006); 6) the effects of quality of education were not controlled, resulting in norms that are too lenient for individuals with advantaged quality of education, and too stringent for those with disadvantaged quality of education (Horsman, 2007); and 7) the marked discrepancies within racial groups were not acknowledged – published norms were inadequately stratified and failed to reflect intra-racial heterogeneity (Shuttleworth-Edwards, Donnelly, Reid, & Radloff, 2004; Shuttleworth-Edwards, Kemp et al., 2004).

Comparisons between the norms published by the Human Sciences Research Council (HSRC), and those collected by Shuttleworth-Edwards et al. (2004), demonstrate the problems inherent in using inadequately stratified norms. For white participants with advantaged education, both norm sets located achievement within the *average* intelligence range (101.35 and 106.5). HSRC norms, which were not stratified for quality of education, located achievement for blacks within the *low average* range (86.41). Using Shuttleworth-Edwards et al.'s stratified norms, however, black participants with advantaged quality of education achieved scores within the *average* range (99.90) and those with disadvantaged quality of education were classified in the *borderline* range (74.00). Both black groups were misclassified by an intelligence quotient (IQ) category (i.e., by at least 15 IQ points, or 1 SD). These findings provide a strong illustration of how inadequately stratified norms can enhance the potential for both false-positive and false-negative diagnoses.

In my study, I intend to reinforce the point made by Shuttleworth-Edwards et al. (2004) that the creation of appropriately stratified norms helps mitigate against misclassifications. My study provides a set of norms, stratified, where necessary, by age, race, language, sex, and quality of education, for an array of cognitive tests that measure a range of cognitive processes.

1.9.2.2. Other lessons learned from South African normative studies

In the absence of appropriate norms for individuals residing in the Western Cape, clinicians tend to transform scores for culturally disadvantaged participants by using a set upward adjustment, for example, 2 scales per subtest, and 10 points per index score on the WISC-IV. It is unclear how these adjustment criteria were established, but it is clear that contemporary and appropriately stratified norms would be useful. Because different tests are differentially affected by the sociodemographic variables, the standardized upward adjustment of scores is neither scientifically acceptable nor clinically useful.

Each study reviewed above has contributed to the field of cognitive psychometry by collecting and publishing normative data. I refer in the three studies discussed below to some of the strengths and limitations that have been demonstrated in normative and cross-cultural research, in order to provide some directive indications for future studies.

The study by Jinabhai et al. (2004) demonstrated particular strengths in terms of 1) screening via medical examination, and 2) substantive sample size (n = 806) within a homogenous population of rural Zulu, disadvantaged primary school children. The researchers used a consultative approach to select tests and to evaluate items for cultural bias. However, a few aspects of the research raise important questions. The adaptation of the AVLT to a written format (to enable group administration) was problematic in that: 1) the results of the written test were compared to norms for the oral administration, which limits the validity of such cross-cultural comparisons; and 2) a written administration of the AVLT introduces graphomotor skill and speed, and elements of literacy such as spelling, as potentially confounding variables not controlled for in the study design. The aforementioned factors are particularly pertinent at the education level of the participants, i.e., grade 3 (Bramao et al., 2007). Also, the authors identified the WHO/UCLA version of the AVLT as having low intercultural variability, but, curiously, did not use this version of the test in their study.

Cave and Grieve's (2009) study was noteworthy for its careful investigation into the quality of education of the selected schools, to confirm the suitability of the categorization of DET schools as disadvantaged, and private schools as advantaged , in terms of quality of education. A limitation of this study is that the small sample of participants with low quality of education (n = 20) was comprised of individuals with no less than 9 different mother-tongue languages (viz., English, Xhosa, Zulu, Sotho, Tswana, Pedi, Venda, Ndebele, and Kgaogelo). This extreme example of a polyglot sample raises questions about the conclusions drawn about quality of education *per se*, without investigating the effects of linguistic factors on executive functioning.

Grieve and van Eeden (2010) investigated the utility of the HSRC-translated (but unstandardized) Afrikaans version of the WAIS-III (Claassen et al., 2001). The authors provided an item analysis of the Vocabulary subtest, thereby providing useful indications of words that were out of sequence (in relation to the intended difficulty level) in two culturally divergent subgroups of Afrikaans speakers. This study thus provided qualitative information regarding the cross-regional suitability of the Vocabulary lists in two divergent Afrikaans-speaking groups (viz., white, urbanized adults with advantaged education, from Gauteng; and coloured, peri-urban or rural adults with disadvantaged education, from the Western Cape). However, the authors used the ill-reputed English norms (Claassen et al., 2001) for converting raw scores to subscale scores; as noted above, these norms are inappropriate for both Afrikaans-speaking groups described in their study. The authors could have calculated their own normative indications (via percentile ranks) which would have provided a valuable interpretive resource for clinicians.

In sum, many lessons have been learned from the attempts to improve the quality, fairness and trustworthiness of tests used in the South African clinical and research context. For example, it is critically important to: 1) test participants in their most proficient language; 2) examine language bias in test items; 3) attempt to ensure culture-fair testing procedures and tests; 4) ascertain the extent to which race, sex, age, language, and level and quality of education affect test performance, and to stratify norms accordingly; 5) treat the assumption that nonverbal tests are unbiased with skepticism; and 6) conduct more normative studies.

1.10. Solutions to norming problems

Considering the complexity of, and room for error that accompanies, using a norm-referenced approach, it must be acknowledged that psychometric measurement of cognitive functioning is an imperfect process. At one extreme, radical anti-test lobbyists oppose any form of quantitative cognitive measurement. At the other extreme, information derived exclusively from intuition, judgment, and experience is no less fallible (Huysamen, 1996; Strauss et al., 2006). Garb (1998), a strong proponent of the empirical approach, argues that the systematic collection and analysis of data is more reliable than clinical judgment. Huysamen (2002, p. 31) concurs with Garb, and asserts that “Professional judgment is a fickle phenomenon...and may be a treacherous ally”. The opinions of opponents of the intuitive approach tend to be shared by professionals outside the fields of psychology and psychometry. For example, the testimony of psychologists in forensic settings has not been rated favourably by lawyers. This is partially due to lack of confidence in inferences that are made in the absence of trustworthy measurement techniques, in both the South African (Allan & Louw, 2001; Bauer, 1997) and the international arenas (Martin, Allan, & Allan, 2008).

Strauss et al. (2006, p. 28), while acknowledging the imperfections in the psychometric approach, adopt a pragmatic compromise:

> Neuropsychological tests need not be perfect, or even psychometrically exceptional; they need only meaningfully improve clinical decision making and significantly reduce errors of judgment – those errors stemming from prejudice, personal bias, halo effects, ignorance, and stereotyping – made by people when judging other people…The judicious selection, appropriate administration, and well-informed interpretation of standardized tests will usually achieve this result.

It is easy to be overwhelmed by the difficulty and complexity of the challenges inherent in testing the cognitive abilities of South Africans. In the spirit of compromise expressed above, I have argued that it is valuable to take an active stance in building up resources that serve the general purpose of improving the quality of norm-referenced cognitive psychometric testing. This dissertation represents one small step in such a quest.

1.11. Study Aims

The general aim of this study was to ascertain whether cognitive tests developed in settings outside of the Western Cape urbanized area have valid application for clinical and research purposes in that area.

I attempt to meet this general aim with four specific strategies, which include:

1. The cultural and linguistic adaptation and modification of non-local psychometric tests of cognitive functioning to suit the local population; and the subsequent administration of the adapted tests in a sample of typically developing, coloured and white, 12- to 15-year-old, Afrikaans- and English-speaking adolescents, resident in the Cape Town urban region of the Western Cape Province;
2. The evaluation of the relative impact of constant factors (i.e., race, sex) and changeable sociocultural factors (i.e., level and quality of education, and language) on cognitive performance, and the consequent derivation of appropriately stratified normative data (i.e., descriptive norm tables and data conversion tables);
3. The evaluation of the utility of the adapted tests and norms by:
    - 3.1. Cross-cultural comparisons using norms collected from the local sample to non-local published norms
    - 3.2. Illustrating the interpretive problems associated with using inappropriate norms.

2. Methods

2.1.1. Research design

A cross-sectional design was used for this normative study, in accordance with nonrandomized selection criteria. This doctoral study was nested primarily within a larger multidisciplinary study (referred to as the *primary study*), viz. "The effects of heavy alcohol abuse on adolescent brain structure and functioning" (project number N/06/07/128; NIH grant RO1 AA016303-01, P.I: G. Fein). Data reported here are from the healthy control participants ($N = 215$) recruited into the primary study. This is the sample for which data is available, for most of the tests (referred to as Test Group 1 in Table 2: i.e., Children's Color Trails Test; Children's Memory Scale – Numbers and Stories Subtests; CLOX Test; Maj's Auditory Verbal Learning Test; Rey-Osterrieth Complex Figure Test; Stroop Color-Word Test; Tower of London; Wechsler Intelligence Scale for Children, 4th UK Edition – Coding Subtest).

Data were available for another group of participants ($n = 71$) for two tests, viz., Verbal Fluency Tests and the Wechsler Abbreviated Scale of Intelligence, resulting in an increased sample size ($N = 286$) for these tests only (referred to as Test Group 2 in Table 2). The supplementary data for those 71 participants were obtained from a parallel study that was initiated after the primary study, viz. "Comparing the utility of the South African adaptations of the Wechsler Abbreviated Scale of Intelligence, the Controlled Oral Word Association Test and the Boston Naming Test for English-, Afrikaans- and Xhosa-speaking 8-25 year olds in the Western Cape Province" (project number N/08/08/227, P.I: H. Ferrett). The only data from the parallel study that I used were from participants who matched the sociodemographic profile of participants in the primary study (i.e., 12- to 15-year-old, coloured and white, Afrikaans- and English-speaking participants).

The sample size for the Grooved Pegboard Tests (referred to as Test Group 3 in Table 2) was smaller than for the other tests ($N = 194$) because I excluded ambidextrous ($n = 10$) and left-handed ($n = 11$) participants from the analyses.

2.1.2. Sites and time frame

Participants from the primary study were tested in the Psychiatry Department at the Tygerberg Campus of Stellenbosch University. These participants were transported between their homes or schools and the University site by study staff with public drivers' permits. Participants from the parallel study were tested at the schools they attended. Data were collected over a 2-year period, between 2008 and 2010.

2.1.3. Participants

A convenience sample of coloured and white, Afrikaans- and English-speaking adolescents, aged between 12 and 15 years, with between 6 and 10 years of completed education, recruited from 47 schools in the greater Cape Town metropolitan region, were included in the study. Participants were recruited from heterogeneous socioeconomic and educational backgrounds. Table 2 presents the sociodemographic characteristics of the sample

2.2. Process

2.2.1. Ethical considerations

For both studies, the protocols and procedures complied with and were conducted in adherence with the guidelines contained in the Declaration of Helsinki (World Medical Association, 2008). Full written approval to conduct the study was obtained from the Western Cape Education Department and the Committee for Human Research at the Tygerberg Campus of Stellenbosch University.

Testing procedures were explained to the participants in their preferred language, and all test material was available in Afrikaans and English. Before test administration began, participants were invited to ask questions about procedural aspects of the testing process, and were informed of their right to withdraw from the study at any time. Written assent was obtained from each participant and written consent from their parents. Duplicate assent/consent forms were provided for participants to keep.

To protect privacy and maintain confidentiality, participants were allocated study identity numbers; their names did not appear on the scoring sheets. Those who declined to participate or withdrew from the study were not penalized in any way.

Participants were compensated for participation with gift vouchers from *Clicks* store to the value of ZAR150 for the primary study and ZAR50 for the parallel study. In cases where screening and testing procedures revealed conditions warranting further investigation or treatment, participants were referred to the appropriate agencies.

Table 2. *Descriptive Statistics for Three Different Samples in the Current Study*

		Test Group 1: Most Cognitive Tests* (*N* = 215)		**Test Group 2: Verbal Fluency Tests and WASI** (*N* = 286)**		**Test Group 3: Grooved Pegboard Test (*N* = 194)**	
Continuous Variables		***M***	***SD***	***M***	***SD***	***M***	***SD***
Age		13.91	1.23	13.82	1.21	13.85	1.23
Education Level		6.96	1.27	6.83	1.31	6.91	1.28
Categorical Variables		***f***	**%**	***f***	**%**	***f***	**%**
Socioeconomic Status Category***	Lower (5-33)	103	47.9	137	47.9	90	46.4
	Higher (34-41)	109	50.7	139	48.6	101	52.1
Sex	Female	117	54.4	154	53.8	108	55.7
	Male	98	45.6	132	46.2	86	44.3
Race	Coloured	148	68.8	207	72.4	133	68.6
	White	67	31.2	79	27.6	61	31.4
Language	Afrikaans	93	43.3	126	44.1	82	42.3
	English	122	56.7	160	55.9	112	57.7
Quality of Education	Advantaged	94	43.7	133	46.5	84	43.3
	Disadvantaged	121	56.3	153	53.5	110	56.7
Race-Language-Quality of Education		***n***	**%**	***n***	**%**	***n***	**%**
Coloured-Afrikaans-Advantaged		6	2.8	16	5.6	4	2.1
Coloured-English-Advantaged		21	9.8	38	13.3	19	9.8
Coloured-Afrikaans-Disadvantaged		77	35.8	90	31.5	69	35.6
Coloured-English-Disadvantaged		44	20.4	63	22.0	41	21.1
White-Afrikaans-Advantaged		10	4.7	20	7.0	9	4.6
White-English-Advantaged		57	26.5	59	20.6	52	26.8
White-Afrikaans-Disadvantaged		0	0	0	0	0	0
White-English-Disadvantaged		0	0	0	0	0	0

Note. * = Children's Color Trails Test; Children's Memory Scales Numbers and Stories Subtests; CLOX Test; Maj's Auditory Verbal Learning Test; Rey-Osterrieth Complex Figure Test; Stroop Color-Word Test; Tower of London; Wechsler Intelligence Scale for Children, 4th UK Edition Coding Subtest; ** = Wechsler Abbreviated Scale of Intelligence; *** = missing data: Test Groups 1 and 3 (n = 3); and Test Group 2 (n = 10).

2.2.2. Recruitment

The studies were advertised by oral presentations (in schools) and by word of mouth. Recruiters met with interested volunteers to discuss inclusion/exclusion criteria, explain study procedures, and answer queries. Once assent/consent had been obtained, self-report questionnaires were completed by participants and their parents/caregivers (see Appendix A) for the purpose of obtaining demographic and pre-screening information. Recruiters visited the schools and/or the homes of participants to assist in completion of the demographic and consent forms, to explain procedures, and to ask and answer questions. Further opportunities for explanation and queries were provided at the screening interviews and prior to cognitive testing.

Once pre-screening information had been evaluated by the study leader to ensure eligibility, interested volunteers were invited to participate. Screening and testing appointment times, dates and venues were pre-arranged at participants' convenience. Participants were tested in school hours, or during school holidays during normal working hours. No participants were tested within the 2 weeks prior to, or during, school examination periods.

2.2.3. Screening materials and procedures

Although exclusionary criteria were the same for the primary and parallel studies, across the two studies different screening instruments were employed by mental health professionals with differing professional qualifications and status: 1) For the primary study, an HPCSA-registered psychiatrist administered the *Schedule for Affective Disorders and Schizophrenia for School Aged Children (6–18 years) Lifetime Version* (K-SADS-PL; J. Kaufman, Birmaher, Brent, Rao, & Ryan, 1996); 2) for the parallel study, an HPCSA-registered clinical psychologist administered the *Mini International Neuropsychiatric Interview for Children and Adolescents* (M.I.N.I. Kid; Sheehan, Shytle, Milo, Janavs, & Lecrubier, 2009).

The K-SADS-PL and the M.I.N.I. Kid are semi-structured clinical diagnostic interviews based on the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV; American Psychiatric Association, 2000) diagnostic criteria, employed to ascertain current and past psychiatric diagnoses, as reported by the participants. Collateral information verifying the absence of medical, psychiatric, and psychosocial problems was obtained orally from consenting parents by a social worker at the consent explanation interview, and in written form on the parental questionnaire. Verification of regular school attendance was obtained from school reports, and school teachers were consulted at pre-screening interviews conducted by a social worker to verify whether participants' behaviour and performance at school were considered to be within normal parameters.

2.2.4. Inclusion and exclusion criteria

The same eligibility criteria were applied for both studies. Self-reported information was corroborated by parents and educators. The following inclusion criteria were applied:

a) Age from 12 to 15 years
b) Current enrollment at a government school in the greater Cape Town region
c) Minimum of 4 years of formal education completed successfully
d) Maximum of 1 school grade repeated
e) Proficiency in Afrikaans or English (i.e., either as home language or as medium of first language instruction at school)

The following exclusion criteria were applied:

a) Mental retardation and/or learning disabilities
b) Current or lifetime DSM-IV Axis I diagnoses (as defined in the screening instruments), including major depression, dysthymia, mania, hypomania, cyclothymia, bipolar disorders, schizoaffective disorders, schizophrenia, schizophreniform disorder, brief reactive psychosis, panic disorder, agoraphobia, separation anxiety disorder, avoidant disorder of childhood and adolescence, simple phobia, social phobia, overanxious disorder, generalized anxiety disorder, obsessive compulsive disorder, attention-deficit/hyperactivity disorder, conduct disorder, oppositional defiant disorder, enuresis, encopresis, anorexia nervosa, bulimia, transient tic disorder, Tourette's disorder, chronic motor or vocal tic disorder, alcohol abuse or dependence, substance abuse or dependence, post-traumatic stress disorder, and adjustment disorders
c) Current use of sedative and/or psychotropic medication
d) Signs or history of fetal alcohol syndrome or malnutrition ascertained by detailed neurological examination and detailed developmental history
e) Speech or language disorders
f) Sensory impairments, including color-blindness (except for visual defects in which the use of spectacles enables 20/20 vision)
g) History of head injury with loss of consciousness exceeding 10 minutes
h) History or presence of diseases affecting the central nervous system, which are likely to affect cognitive functioning (e.g., meningitis, encephalitis, epilepsy, HIV)
i) History of prenatal or birth complications

j) History of severe behavioral abnormalities or social adjustment difficulties within the school setting

k) Psychometric testing within the past 12 months

A total of 33 of the 320 participants screened (10.31%) were ineligible for study participation due to the following reasons: current psychopathology, including major depression (n = 3), bipolar disorder (n = 1), psychotic symptoms (n = 2), post-traumatic stress disorder (n = 2), separation anxiety (n = 1), attention-deficit/hyperactivity disorder (n = 3); regular use of illicit substances (n = 5); current use of psychotropic medication (n = 2); unilateral blindness (n = 1); HIV infection (n = 1); head injury (n = 3); recent psychometric testing (n = 1); social and/or behavioural problems at school (n = 5); birth complications (n = 1); and suspected learning disorders (n = 2). Data from one participant were excluded because she was the only white participant with disadvantaged quality of education.

2.2.5. Testing procedures

Cognitive tests were individually administered in a quiet testing location with adequate lighting and ventilation. Testing was re-scheduled for participants who were unwell, fatigued, or who did not bring their spectacles (if prescribed) at the original test date. Refreshments were provided for the participants before testing. Test duration ranged between 135 and 165 minutes for the primary study, and between 25 and 40 minutes for the parallel study. Breaks were encouraged during the longer test battery.

More than half (61%) of the participants were personally tested by me (i.e., an HPCSA-registered and experienced clinical psychologist). I was trained and supervised by external consultants with considerable local and international expertise in the field of adolescent neuropsychology, viz., Dr. Kevin Thomas (University of Cape Town) and Prof. Susan Tapert (University of California at San Diego). The remaining participants were tested by six post-graduate psychology students who were trained and supervised by me and Dr. Thomas.

Attempts were made to keep testing administration procedures consistent. All testers used identical test manuals, with verbatim test instructions and compiled specifically for the purposes of the study, and I scored all the tests. With the permission of the participants, some of the tests (e.g., Verbal Fluency and CMS Story Memory) were audio-taped to ensure verbatim recording of data. Recordings were deleted immediately after the material had been transcribed into the response booklets. These transcriptions were done immediately after testing, in order to safeguard the confidentiality of the test material. A further attempt to safeguard the integrity of the test material was made by requesting participants not to reveal the details of the test stimuli (for example, which letters, categories, or pictures were used) to other participants.

2.3. Materials and measures: independent variables

Demographic information was recorded on the self-reported (or clinician-assisted) participant and parent/caregiver information questionnaires (see Appendix A). Specific demographic details relevant to cognitive testing (language, age, school grades repeated) were confirmed and recorded by the tester in the test booklets. Information about educational history (specifically, which schools the participant had attended since Grade 1) was recorded by the social worker at the pre-screening phase of the study. I refer to variables as *constant* (specifically, sex and race), *changeable* (specifically, age and cross-cultural factors, including language, level and quality of education, and socioeconomic status), as described in Section 1.7.6.

2.3.1. Constant independent variables

Sex: I use the term *sex* (i.e., a fixed biological variable) rather than *gender*, based on an Oxford dictionary definition that differentiates between the use of the words: "*sex* tends to refer to biological differences, while *gender* tends to refer to cultural or social ones" (Soanes & Stevenson, 2006, p. 592). Group sizes for males and females did not differ significantly (Test Group 1: female = 54.4%, male = 45.6%; Test Group 2: female = 53/8%, male = 46.2%); Test Group 3: female = 55.7%, male = 44.3%).

Race: Participants reported their race on the demographic questionnaire. None of the participants declined to identify their race, although they were, for ethical reasons, given the opportunity to do so. All participants identified themselves as *coloured* or *white* (rather than *black*, *Asian*, or *other*), as described in census publications (Statistics South Africa, 2001). The racial composition of the sample was unevenly distributed, with more coloured than white participants (Test Group 1: coloured = 68.8%, white = 31.2%; Test Group 2: coloured = 72.4%, white = 27.6%; Test Group 3: coloured = 68.6%, white = 31.4%). However, the racial distribution of the sample was similar to the racial distribution in the Western Cape Province, where coloureds (50%) outnumber whites (20%; Statistics South Africa, 2007).

2.3.2. Changeable independent variables

Age: The chronological age of the participant was recorded on the date of cognitive testing. Age was calculated according to the system specified in the Wechsler Abbreviated Scale of

Intelligence (Psychological Corporation, 1999), whereby the participant's date of birth is subtracted from the date of testing. For the age computations, all months are treated as having 30 days, and days and months are not rounded up. Age was recorded in years, months, and days, for the purposes of computing relevant age-adjusted standardized scores (e.g., *T*-scores or IQ scores). For computational purposes, data analyses, and in all norm tables, age was recorded as a mathematical unit.

Test language: This variable refers to the language in which the participant was tested, and was determined by the participant's self-selected preferred (and most proficient) language. For 88% of participants, language of testing was congruent with home language, and with first-language tuition at school. The remaining 12% of participants considered themselves to be more proficient in their language of education, and chose to be tested in this medium rather than in their home language. Field observations during testing revealed a high degree of code switching (particularly in coloured participants) and bilingualism. However, detailed linguistic aspects (as described in Section 1.7.7.5) were not formally evaluated in either the primary study or the parallel study. Group sizes for Afrikaans- and English-speakers were not significantly different (Test Group 1: Afrikaans = 43.3%, English = 56.7%; Test Group 2: Afrikaans = 44.1%, English = 55.9%; Test Group 3: Afrikaans = 55.7%; English = 44.3%).

Level of education: This variable was defined as whole years of successfully completed education. In order to prevent the potential confounding effects of age and level of education, which were strongly positively correlated (Test Group 1: $r_s = 0.90$, $p < .001$; Test Group 2: $r_s = 0.91$; Test Group 3: $r_s = 0.90$), age was investigated as a potentially influential variable for norm stratification purposes, whereas level of education was used for descriptive purposes only.

Quality of education: The South African studies reviewed in Sections 1.7.8 and 1.9.2 show that it is clinically informative to measure the impact of quality of education, and its association with racial-linguistic profiles, when interpreting cognitive test results. Without exception, these studies differentiated between good/advantaged and poor/disadvantaged quality of education, which was operationally defined as a dichotomous categorical variable. In all the studies, the two groups were defined according to the parliamentary classification given to segregated schools prior to democratization, for example, Model C, Department of Education and Training (DET), House of Representatives (HOR), or Private. In some studies, the researchers conducted site evaluations to confirm qualitatively the designated classification of advantaged or disadvantaged quality of education (e.g., Cavé & Grieve, 2009). In other studies, quality of education, though not directly evaluated, was described qualitatively, based on assumptions derived from an understanding of South Africa's political and socioeconomic history (Jinabhai et al., 2004). Although the duration of exposure to particular types of education was described in only a few studies (Shuttleworth-Edwards, Kemp et al., 2004), most authors did not specify duration within education systems, nor the incidence or duration of change from one system to another.

Following some of the precedents described above, I defined quality of education as a dichotomous variable with two assumed levels (advantaged or disadvantaged) of government schooling (i.e., no participants from private schools were included in the study). I used the official provincial records (Western Cape Education Department, 2010) and nomenclature to confirm the pre-democratization classifications of the schools. *Advantaged* schools included those that were previously only accessible to white children, but had been opened to other races for the last 15 years, viz., *Cape Education Department (CED),* or *Western Cape Education (WCE)* (collectively referred to as *Model C* in other studies). *Disadvantaged* schools included those previously reserved for children who were not white, viz., *DET* for black children; *HOR* for mixed-race/coloured children; and *House of Delegates (HOD)* for children of Asian descent. In this study, as the sample consisted only of coloured and white participants, disadvantaged quality of education was only represented by HOR schools.

Disadvantaged schools have historically been allocated fewer human, instrumental, and financial resources than advantaged schools. A qualitative profile of typically disadvantaged schools (in comparison with advantaged schools) could be described as follows: 1) geographic location within poorer areas with lower levels of safety (due to higher levels of interpersonal crime, gangsterism, drug abuse, and vandalism); 2) allocation of fewer human resources (higher learner-educator ratios, higher levels of classroom overcrowding, lower qualified and salaried staff, poorer proficiency of educators in language of instruction; higher absenteeism rates for educators and learners); 3) allocation of fewer material resources (fewer books, computers, teacher aids; poorly equipped libraries and science laboratories); 4) fewer extra-curricular resources (fewer facilities and less manpower for extra-mural resources and extension subjects, e.g., arts, additional languages, computer studies); and 4) poorer educational outcomes (earlier school drop-out rates; higher incidence of teenage pregnancies; lower pass rates at Grade 7 and Grade 12 levels, and lower university admission rates).

A total of 47 government schools were used in this study (advantaged = 19; disadvantaged = 28). Details of previous schooling (from Grade 1 onwards) were recorded, in order to ascertain the duration within advantaged/disadvantaged education systems, and whether participants had changed from one system to another. Most (122/133: 91.7%) of the advantaged participants had received between 6 and 10 years of education only within the advantaged school system. Eleven participants (8.3%) had moved from disadvantaged to advantaged systems within the foundation phase, thus had received between 4 and 8 years of advantaged education. The majority (139/153: 90.8%) of the disadvantaged learners had only been exposed to disadvantaged quality of education. Of the 14 (9.2%) participants who had switched systems, 3 had moved into advanced systems for less than a year, then returned to disadvantaged systems; 2 had started school in advantaged systems, but had moved to disadvantaged schools after failing Grade 1, and had remained in disadvantaged systems thereafter; and 9 had moved from disadvantaged primary schools to advantaged high schools, but were tested within 3 months of starting high school. Consequently, all 14 of the abovementioned participants were classified as having received between 5 and 9 years of predominantly disadvantaged education. The group with advantaged quality of education included coloured and white participants, but the group with disadvantaged quality of education only included coloured participants.

2.3.3. Measures of socioeconomic status

As socioeconomic status (SES) is a multidimensional phenomenon, numerous environmental aspects were measured to attempt to characterize the participants. These included familial characteristics (family income, parental education level, and employment); and household characteristics (basic assets, dwelling type, and bedroom cohabitation). Unsurprisingly, lower socioeconomic status was strongly positively correlated with the coloured race (Test Group 1: $r_s = 0.60$, $p < .001$; Test Group 2: $r_s = 0.61$, $p < .001$; Test Group 3: $r_s = 0.60$, $p < .001$) and with disadvantaged quality of education (Test Group 1: $r_s = 0.64$, $p < .001$; Test Group 2: $r_s = 0.64$, $p < .001$; Test Group 3: $r_s = 0.65$ $p < .001$). Because of the proven utility of analyzing the effects of race and quality of education on cognitive performance in South African normative research, I included these variables in the analyses, in preference to SES. Consequently, SES was only used qualitatively to characterize the sample (see Appendix B).

The relationship between quality of education and the elements of socioeconomic status are graphically illustrated in Appendix B. The composite SES score was transformed into a categorical variable by median split to indicate lower (5 to 33) and higher (34 to 41) status. All the measured elements of socioeconomic status were positively correlated with quality of education. Participants with disadvantaged quality of education came from backgrounds with lower household income levels, $\chi^2 = 113.26$, $p < .001$, and with fewer assets, $\chi^2 = 69.95$, $p < .001$, compared to participants with advantaged quality of education. Their parents were also less educated, $\chi^2 = 81.16$, $p < .001$, with lower professional status and earning potential, $\chi^2 = 93.06$, $p < .001$. Disadvantaged participants were more likely to live in overcrowded conditions, $\chi^2 = 94.22$, $p < .001$, and in smaller dwellings with lower financial value, $\chi^2 = 34.95$, $p < .001$.

Family income: Gross annual income for the combined household was recorded across six income bands, ascending in increments of monetary worth (i.e., 1) < ZAR10 000; 2) ZAR10 000 - 20 000; 3) ZAR20 000 - 40 000; 4) ZAR40 000 - 60 000; 5) ZAR60 000 - 100 000; 6) > R100 000).

The forms were initially incorrectly designed with overlapping categories (e.g., ZAR20 000 was notated as the endpoint of category 2 and the starting point of category 3). To prevent confusion, recruitment staff assisted the parents in completing the forms. They were instructed to carry over the ambiguous figures to the higher categories. An income of R20 000, for example, was recorded in category 3 (ZAR20 000 - 39 999). The recruitment staff verified the corrected data with the 22 parents (7.7%) who had completed the incorrectly designed questionnaires. This incorrect and confusing design was subsequently corrected for the remainder of the participants.

Parental education: The level of education attained by the participants' most educated current caregiver was recorded as a categorical variable in 6 educational bands, from lowest to highest, as follows: 1) 0 years completed (no formal education); 2) 1 to 6 years completed (partial primary school education); 3) 7 years completed (primary school education); 4) 8 to 11 years completed (partial secondary school education); 5) 12 years completed (secondary school education); 6) 13 or more years completed (tertiary college/university education).

Parental employment: Caregivers of participants currently co-habiting with participants named their professions. The researcher then classified the professions into Hollingshead's (1975) employment categories, and recorded the employment category of the co-habiting caregiver with the higher-ranking occupation. The categories are ranked from highest to lowest according to Hollingshead's model, as follows: 1) higher executives, major professionals, large business owners; 2) managers of medium sized businesses, lesser professionals; 3) administrators, small business owners, minor professionals; 4) clerical, sales, technicians; 5) skilled manual; 6) semi-skilled; 7) unskilled; 8) home maker; 9) student, disabled, no occupation, unemployed.

Household assets: I used an abbreviated 7-item version of Myer et al.'s (2008) 17-item asset index. One point was allocated for each endorsed asset or facility (i.e., tap water, flushing toilet, electricity, landline telephone, television, computer, and motor vehicle).

Dwelling type: This variable was rated according to an ascending index of socioeconomic value, ranked in ascending order, as follows: 1) shack; 2) wendy house or backyard dwelling; 3) tent or traditional dwelling; 4) flat or apartment; 5) town house or semi-detached house; 6) freestanding brick house.

Bedroom cohabitation: As an indication of potential overcrowding, participants recorded the number of other people that shared their bedroom with them at night. Lower scores reflect higher estimated indices of overcrowding, as follows: 1) more than 5 cohabitants; 2) 5 cohabitants; 3) 4 cohabitants; 4) 3 cohabitants; 5) 2 cohabitants; 6) 1 cohabitant; 7) no cohabitants.

SES composite score: The self-reported total scores of the abovementioned measures were summed to create a composite SES score, ranging from 5-41 points, with lower scores indicating lower SES, as follows: 1) family income (range: 1 to 6); 2) parental education level (range: 1 to 6); 3) parental employment (Hollingshead scores were reverse-scored so that higher scores reflected higher occupational status; range: 1 to 9); 4) household asset total (range: 0 to 7); 5) dwelling type (range: 1 to 6); and 6) bedroom cohabitation (range: 1 to 7).

2.4. Materials and measures: dependent (cognitive) variables

Although this study has applicability beyond the field of neuropsychology, as explained in the introduction, neuropsychology has provided a useful paradigm for organizing information about cognitive functioning. Consequently, I used three core neuropsychological texts (Lezak et al., 2004; Mitrushina et al., 2005; Strauss et al., 2006); manuals provided by test developers; and relevant peer-reviewed literature, to select and describe the functional cognitive domains measured in this study, and to guide my decision-making with regard to which tests to use to measure each domain, and which norms to use for cross-cultural comparisons.

The dependent variables in this study were the scores attained by participants on an eclectic collection of non-local tests (translated and adapted/unadapted), that measure numerous domains and subdomains of cognitive functioning. The domains measured, and the corresponding subtests/tests used to measure each domain, are listed in Table 3. I have cited references to studies that have reported acceptable levels of test-retest reliability (or temporal stability) and construct validity, where such information is available for adolescent samples. Where information about the psychometric properties of the measures has not been reported for adolescents, I cited coefficients and validity references from studies that were conducted on adult samples.

2.4.1. Summary of test selection criteria

Many factors were considered in the selection of a collection of psychometric tests capable of measuring a range of functional cognitive domains, and likely to be useful in the South African context as well as for international cross-cultural comparisons. I selected tests that met as many of the criteria (described in detail in Section 1.6) as possible. In summary, I selected tests that had been:

1) accredited in peer-reviewed publications as conceptually and psychometrically sound with quantifiable dependent variables;
2) demonstrated to have satisfactory test-retest reliability and construct validity (see Table 3);
3) demonstrated to be age-appropriate for adolescents;
4) specifically designed within the paradigm of developmental psychology; or,
5) designed for adults, but capable of successful downward extension for adolescents;
6) appropriate for longitudinal follow-up;
7) specifically designed to reduce cultural bias; or,
8) able to be adapted to substitute or remove potentially biased items;
9) included in Mitrushina et al.'s (2005) meta-analytic studies, thereby demonstrating a history of cross-cultural utility;
10) feasible within the constraints of the mother study and sensible clinical practice (i.e., time-efficient, financially affordable, easy to transport, relatively impervious to administration and scoring inconsistencies); and,
11) capable of extending the range of tests that have already been standardized or normed for South African adolescents.

Idiosyncratic test selection criteria not described in the summary above are contained in section 2.4.2. In section 2.4.2., each test (arranged in alphabetical order) is described in detail. I explain administration and scoring procedures and the utility of each test. I also report whether the independent variables specified in this dissertation have been shown to influence cognitive test performance in adolescent populations, and/or in coloured or white, Afrikaans- or English-speaking, South Africans.

2.4.1.1. Selection criteria for non-local comparative norms

In keeping with standard clinical practice, as a first choice I selected comparative norms that were supplied by the test developers with the test material. For most of the *t*-test comparisons, I used non-local norms that were published in the test manuals. I thus provided data specific to 12- to 15-year-olds, for the specific tests used, and derived from standardization samples with large sample sizes, with accompanying data for reliability and validity pertinent to the non-local population. The tests/test batteries for which this practice was applied were: 1) CCTT (Llorente et al., 2003); 2) CMS Numbers and Stories Subtests (Cohen, 1997); 3) GPT 1 (Trites, 1977); 4) ROCFT (Meyers & Meyers, 1996); 5) SCWT (Golden et al., 2003); 6) ToL (Culbertson & Zillmer, 2001); 7) WISC-IV Coding Subtest (Wechsler, 2004); and 8) WASI (Psychological Corporation, 1999).

For three tests that were not purchased through test-development companies, I used norms from recently published journal articles, for age groups that were as close as possible to my sample. Those tests were: 1) CLOX, ages 20 to 28 (Royall, Cordes, & Polk, 1998); 2) GPT 2, ages 18 to 24 (Bryden & Roy, 2005); and 3) MAVLT, ages 16 to 29 (Pontón et al., 1996). For Verbal Fluency tests, I selected norms for idiosyncratic reasons that are explained in the results/discussion. South African age-matched data existed for the same test version for one outcome measure: the WISC-IV Coding Subtest (Shuttleworth-Edwards et al., in press). In that case, I compared the study norms to the Shuttleworth-Edwards et al.'s (in press) data, as well as to Wechsler's (2004) UK standardization norms.

Table 3. *Functional Cognitive Domains, Cognitive Tests and Subtests, Test-retest Reliability Coefficients, and References to Studies Describing Construct Validity*

Domains and Subdomains	Tests and Subtests	Test-retest Reliability	Validity Reference
Intelligence: General intelligence (*g*)	WASI Full Scale IQ	r_{tt} = .95 (Psychological Corporation, 1999)	Psychological Corporation, 1999
Verbal/crystallized intelligence	WASI Verbal IQ (Vocabulary and Similarities Subtests)	r_{tt} = .94 (Psychological Corporation, 1999)	
Performance/fluid intelligence	WASI Performance IQ (Block Design and Matrix Reasoning)	r_{tt} = .90 (Psychological Corporation, 1999)	
Simple attention	CMS Numbers Forward	r_{tt} = .86 (Cohen, 1997)	M Cohen, 1997
Fine-motor coordination	GPT Peg Insertion Time	Dominant hand: r_{tt} = .76; Nondominant hand: r_{tt} = .78 (Ruff & Parker, 1993) - adults	Ruff & Parker, 1993- adults
Visuospatial construction abilities: Non-speeded	CLOX Trial 2	r_{tt} = .93 (Royall et al., 1998)	Royall et al, 1998
	ROCFT Copy	r_{tt} = .89 (Meyers & Meyers, 1996)	Meyers & Meyers, 1996
Speeded	WASI Block Design Subtest	r_{tt} = .87 (Psychological Corporation, 1999)	Psychological Corporation, 1999
Memory: Encoding	CMS Numbers Forward	r_{tt} = .86 (Cohen, 1997)	M. Cohen, 1997
	MAVLT Trial 1	NR*	Ponton et al., 1996
Short term retention (verbal)	CMS Stories Immediate Recall	r_{tt} = .85 (Cohen, 1997)	M. Cohen, 1997
	MAVLT Immediate Recall	NR*	Ponton et al., 1997
Short term retention (visual)	ROCFT Immediate Recall	r_{tt} = .76 (Meyers & Meyers, 1996)	Meyers & Meyers, 1996
Long-term retention (verbal)	CMS Stories Delayed Recall	r_{tt} = .85 (Cohen, 1997)	M. Cohen, 1997
	MAVLT Delayed Recall	NR*	M. Cohen, 1997
Long-term retention (visual)	ROCFT Delayed Recall	r_{tt} = .89 (Meyers & Meyers, 1996)	Meyers & Meyers, 1996
Retrieval	CMS Stories Recognition	NR	NR
	MAVLT Recognition	NR*	Ponton et al., 1997
Learning	MAVLT Learning Rate	NR*	NR
Forgetting	MAVLT Forgetting Rate	NR*	NR

Domains and Subdomains	Tests and Subtests	Test-retest Reliability	Validity Reference
Executive Functioning:			
Attentional control: Selective attention	CCTT Trial 1 Completion Time	r_{tt} = .95 (Llorente et al., 2002)	Llorente et al., 2002
Self-monitoring	ToL Rule Violations	r_{tt} = .67 (Culbertson & Zillmer, 2001)	NR
	MAVLT Total Errors	NR	NR
	Verbal Fluency Total Errors	NR	NR
Information processing speed	WISC-IV Coding Subtest	r_{tt} = .86 (Wechsler, 2004)	Wechsler, 2004
	GPT Peg Removal Time	NR	Bryden & Roy, 2005
	ROCFT Copy Time	r_{tt} = .78 (Meyers & Meyers, 1996)	NR
	ToL Time Violations	r_{tt} = .24 (Culbertson & Zillmer, 2001)	NR
	ToL Problem-solving Time	NR	NR
Cognitive flexibility: Working memory	CMS Numbers Backwards	r_{tt} = .86 (Cohen, 1997)	M. Cohen, 1997
Set-shifting	CCTT 2 Completion Time	r_{tt} = .68 (Llorente et al., 2002)	Llorente et al., 2002
	Phonemic Fluency Total Words	r_{tt} = .68 (Barr, 2003) – different letters	Ruff, Light, Parker, & Levin, 1997 – different letters, adults
	Semantic Fluency Total Words	r_{tt} = .77 (Levine, Miller, Becker, Selnes, & Cohen, 2004)	Levin et al., 2004
Response inhibition	CCTT Interference Index	r_{tt} = .78 (Llorente et al., 2002)	NR
	SCWT Color-Word Page Total Correct	r_{tt} = .73 (Golden, 1975) - adults	Shum, McFarland, & Bain, 1990
	SCWT Interference Index	r_{tt} = .70 (Golden, 1975) - adults	Shum et al., 1990
Goal setting (planning and organization)	CLOX Trial 1	r_{tt} = .94 (Royall et al., 1998)	Royall et al., 1998
	ToL Total Correct	r_{tt} = .80 (Culbertson & Zillmer, 2001)	Culbertson & Zillmer, 2001
	ROCFT Organization	r_{tt} = .79 to .94 (P. Anderson, Anderson, & Garth, 2001)	P. Anderson et al, 2001

Note. NR = Not Reported; NR* NR, but acceptable coefficients have been recorded for alternative AVLT versions (Strauss et al., 2006); r_{tt} = test-retest reliability coefficient; CCTT = Children's Color Trails Test; CMS = Children's Memory Scales; GPT = Grooved Pegboard Test; MAVLT = Maj's Auditory Verbal Learning Test (WHO/UCLA version); ROCFT = Rey-Osterrieth Complex Figure Test; SCWT = Stroop Color-Word Test; ToL = Tower of London; WASI = Wechsler Abbreviated Scale of Intelligence; WISC-IV = Wechsler Intelligence Scale for Children (4th UK Edition).

2.4.2. Descriptions of cognitive tests

2.4.2.1. Children's Color Trails Test (CCTT)

2.4.2.1.1. Description of the CCTT

The Children's Color Trails Test (CCTT; Llorente et al., 2003) requires participants to draw a line connecting visual stimuli (similar to *join-the-dots* games) as fast as possible. It consists of two trials. The first trial (CCTT 1) involves connecting coloured and numbered circles. The second, more complex, trial (CCTT 2) contains distracter items in the form of duplicated items (i.e., each number is presented twice, in pink or yellow coloured circles). The CCTT measures various components of visual attentional and executive skills (Llorente et al., 2003).

2.4.2.1.2. Administration procedures for the CCTT

Although four versions of the CCTT are available, norms are only available for form K (Llorente et al., 2003), which is the version I used. Test equipment consists of four stimulus cards, a score sheet, a pencil, and a stopwatch. Each of the CCTT trials is preceded by a practice trial, which is not scored. Preliminary procedures involve checking that participants are able to count correctly from 1-15, instructing them to hold the pencil in its centre (to prevent the participant's hand from obscuring the view of the target circles) and to not lift the pencil off the page during each task.

In CCTT 1, participants are instructed to draw a line connecting the 15 numbered and colored circles sequentially as fast as possible. For CCTT 2, participants are required to connect the circles sequentially by number, but also in alternating order of colours (e.g., pink 1, yellow 2, pink 3, etc.), ignoring the distracter items (e.g., yellow 1, pink 2, etc.; Llorente et al., 2003).

2.4.2.1.3. Scoring procedures for the CCTT

For both CCTT trials, *completion time* is measured in seconds. Timing begins when movement towards the first circle is detected, and ends when the pencil touches the outside edge of the final circle. Errors (i.e., number and color sequence errors, prompts, and near-misses) are tallied by the examiner.

Number sequence errors are mistakes made in following the sequencing of numbers from 1 to 15. *Color sequence errors* (in CCTT 2) occur when the participant incorrectly alternates between pink and yellow circles. *Prompts* are cues provided by the examiner (i.e., pointing to the correct circle) if the participant does not make a response for 10 seconds (Llorente et al., 2003). *Near-misses* occur when the participant initiates an erroneous response, but manages to self-correct before connecting the line to a distracter circle (Mitrushina et al., 2005).

The *interference* score compares the participant's performance on CCTT 1 and CCTT 2 (Llorente et al., 2003), and is calculated as follows: (CCTT 2 Completion Time minus CCTT 1 Completion Time) divided by (CCTT 1 Completion Time).

2.4.2.1.4. The utility of the CCTT

The CCTT measures various components of visual attentional and executive skills. Specifically, CCTT 1 measures perceptual tracking, simple sustained attention, and graphomotor skills. CCTT 2 measures the same skills as CCTT 1, and also measures complex (divided) attention, sequencing skills, and inhibition-disinhibition. CCTT 2 completion times tend to be slower than CCTT 1 times, due to the relative complexity of the latter task (Williams et al., 1995). CCTT 2 is thus more sensitive to emerging executive dysfunction, and associated with frontal lobe impairment (Lezak et al., 2004; Llorente et al., 2003).

CCTT error scores are useful indicators of subtle cognitive slippage that are sometimes difficult to detect in milder neurological conditions. Although norms are not available for CCTT near-misses, these particular errors have proved to be useful indicators of cognitive slippage in adults (Llorente et al., 2003; Mitrushina et al., 2005).

The interference score yields an indication of the presence or absence of cognitive interference, and difficulties with alternating and sequencing skills. A score of 0 indicates no interference, whereas scores of 1 or 5, for example, indicate that the participant took twice or six times as long to perform CCTT 2 compared to CCTT 1. Interference scores above 3 are considered to be clinically significant indicators of cognitive interference and poor alternating and sequencing skills (Llorente et al., 2003; Mitrushina et al., 2005).

Research has demonstrated that in comparison to healthy controls, children and adolescents with mild brain injury, ADHD, or learning disabilities achieve slower completion times (Voigt et al., 2001), higher error scores, and higher interference rates on the CCTT (Llorente et al., 2003; Voigt et al., 2001).

Utility for adolescents and in cross-cultural contexts

The CCTT is a children's equivalent of the Color Trails Test (CTT) for adults (D'Elia, Satz, Uchiyama, & White, 1996). The CCTT, which is not contingent on familiarity with the English language, but does require familiarity with the Arabic numbering system from 1-15 (Berger, 1998), was commissioned by the World Health Organization (WHO; Mitrushina et al., 2005; Strauss et al., 2006; World Health Organization, 1990), primarily to create a less culturally-biased replacement for the abbreviated Children's Trail Making Tests (CTMT; Reitan, 1971).

The CTMT is a downward extension of the Trail Making Tests (TMT) for adults (Reitan, 1979). Problems with the CTMT included the use of the English alphabet in trial B, which was considered restrictive for non-English speakers (Laosa, 1984), resulting in poorer performance in other cultures, including South African adolescents (Rosin & Levett, 1989a). Llorente et al. (2003) demonstrated that the CCTT seems less culturally biased than the CTMT within the American population, as there were no significant differences between ethnic groups on any measure of CCTT performance. Although Rosin and Levett (1989b) demonstrated that South African children performed worse than Americans on the CTMT, it is not known whether the performance bias has been reduced by the CCTT.

The CCTT, and particularly CCTT 2, appears to be more sensitive than the TMT at discriminating between typically developing children and those with learning disorders, or those with mild neurological conditions (Williams et al., 1995). The discriminatory capacity of trial B of the original TMT was also compromised by overlearning of the English alphabet, which resulted in memory encoding, even in non-English speakers. To avoid this potentially confounding effect, letters of the alphabet were replaced with colors in the CCTT and the CTT (Llorente et al., 2003; Mitrushina et al., 2005; Strauss et al., 2006). The CCTT is, therefore, useful in individuals with limited education, or with language or reading disorders (Mitrushina et al., 2005).

Another problem with the original TMT is that the test material has been compromised by extensive photocopying, resulting in distorted versions, with differing distances between stimulus items (Llorente et al., 2003; Mitrushina et al., 2005). Authors of the CTT and CCTT attempted to address this problem by designing stimuli with vivid colors and unusual paper sizes, to discourage illegal reproductions and thereby encourage the use of formal, standardized test material.

Because test instructions are also available visually, in the form of symbols, the utility of the CCTT has been extended to other-language speakers and to participants with learning disabilities and hearing impairments (Llorente et al., 2003; Mitrushina et al., 2005). It is also possible to use the CCTT with participants who are completely color-blind, as the pink and yellow circles are distinguishable as dark and light gray, respectively (Llorente et al., 2003; Mitrushina et al., 2005). The CCTT was developed specifically for children, using theories of maturation and development rooted in paediatric neurology and psychopathology, rather than simply abbreviating or downscaling an adult test to use for children (Llorente et al., 2003; Mitrushina et al., 2005).

2.4.2.1.5. Sociodemographic variables that influence CCTT performance

Age: In childhood and adolescence, age influences CCTT performance. CCTT completion times, interference effects, and sequence errors tend to decrease with ascending age until early adolescence, although performance appears to remain consistent between the ages of 12 and 16 (Llorente et al., 2003; Williams et al., 1995).

Sex: Seemingly contradictory sex effects have been reported, with a modest male advantage for CCTT 1 completion time (Llorente et al., 2003) , and a modest female advantage for CCTT 2 time (Williams et al., 1995). Sex differences have not been demonstrated for CCTT errors, or for interference effects (Llorente et al., 2003).

Race, language, and quality of education: Language effects have been demonstrated in the CCTT. Chinese speakers, for example, completed both CCTT trials faster than Chinese-English bilinguals and English children in a Hong Kong sample (Mok, Tsang, Lee, & Llorente, 2008). The impact of race and quality of education on CCTT performance has not been reported.

Other influential variables: Higher IQ is related to faster CCTT times in children and adolescents (Williams et al., 1995).

2.4.2.2. Children's Memory Scales (CMS): Numbers Subtest

I used two subtests from the Children's Memory Scales (CMS; Cohen, 1997), viz., Numbers and Stories. The CMS, which is similar to the adult Wechsler Memory Scales (WMS; Strauss et al., 2006), consists of a battery of memory tests yielding a set of scaled scores for different aspects of memory, and various index scores which represent composite domains. As I only used two subtests from the CMS, I did not use index scores in this study.

2.4.2.2.1. Description of the CMS Numbers Subtest

The Numbers subtest, which is equivalent to other digit span tests, requires participants to repeat digit sequences of gradually increasing length. In the Numbers Forward subtest, the participant repeats the number sequences in the same order as the examiner presents them. In the Numbers Backward trial, the participant recalls the digit sequences in reverse order of presentation. The latter task is considerably more taxing than the former, because it necessitates temporarily retaining the numbers, while simultaneously manipulating the information in order to reproduce it in reverse order (Cohen, 1997; Conklin, Luciana, Hooper, & Yarger, 2007). Numbers Forward is a measure of attention and immediate verbal recall, whereas Numbers Backward measures working memory (Conklin et al., 2007; Lezak et al., 2004; Ostrosky-Solís & Oberg, 2006).

2.4.2.2.2. Administration procedures for the CMS Numbers Subtest

Test materials consist of the stimulus material (i.e., standardized lists of random sequences of numbers) and a score sheet. The numbers are presented at a rate of one second per digit, and Numbers Forward precedes Numbers Backward. Two trials are given for each set of digits (i.e., two trials for 2-digit span, two trials for 3-digit span etc., increasing up to 9 digits for Numbers Forward and 8 digits for Numbers Backward). The test is discontinued when the participant fails to remember both sets of numbers within a particular span (e.g., 6 digits) accurately. In this study, test administration procedures published in the manual were followed exactly.

2.4.2.2.3. Scoring procedures for the CMS Numbers Subtest

Responses are recorded verbatim, and each correctly recalled trial is awarded one point, until the discontinuation criterion is met. Scores range from 0 to 16 for Numbers Forward and 0 to 14 for Numbers Backward. Aside from omitting the combined Numbers Forward and Backward score, the scoring procedures published in the test manual (Cohen, 1997) were followed exactly.

2.4.2.2.4. The utility of the CMS Numbers Subtest

In the CMS, Numbers Forward and Numbers Backward are combined to create a composite scale for attention. There is, however, little substantive evidence of the utility of a composite score combining Numbers Forward and Numbers Backward (Lezak et al., 2004; Strauss et al., 2006). The two subtests have been shown to measure different aspects of memory, and are differentially affected by brain damage (e.g., Banken, 1985; E. Kaplan, Fein, Morris, & Delis, 1991; Lezak, 1995; Rudel & Denckla, 1974; Strauss et al., 2006). Furthermore, Cohen's (Cohen, 1997) CMS normative study showed a low correlation (.34) between Numbers Forward and Numbers Backward. Lezak describes how combining digit span scores results in lost information and compromises the utility of the subtests: "For neuropsychological purposes, none of the Wechsler scoring systems (for digit span) is useful. Digit span forward and digit span reversed are meaningful pieces of information that require no further elaboration for interpretation" (Lezak et al., 2004, p. 352). For these reasons, I chose to report Numbers Forward and Numbers Backward separately, and not as a composite measure.

It is difficult to ascertain the effects of Numbers Forward and Numbers Backward in isolation, as the findings tend to be reported as combined scores. Deficiencies in digit span tasks have, however, been observed in children and adolescents with neurodevelopmental disorders such as ADHD (Cahn & Marcotte, 1995; Cohen, 1997; Hynd & Willis, 1988; Korkman & Pesonen, 1994); learning disorders (Cohen, 1997; Silver & Tipps, 1993); and speech and language impairments (Cohen, 1997; Records, Tomblin, & Buckwalter, 1995; Silver & Tipps, 1993).

2.4.2.2.5. Sociodemographic variables that influence CMS Numbers Subtest performance

Age: Performance on both CMS Numbers tasks has shown to improve during adolescence (Cohen, 1997). Numbers Forward performance seems to stabilize between 13 and 15 years, however, while Numbers Backward performance continues to develop until the age of 17 (Conklin et al., 2007).

Sex: Meta-analyses of digit span tasks in children and adolescents have revealed no significant sex differences in performance (Lynn & Irwing, 2008).

Race, language, and quality of education: Differences have been found in cross-cultural meta-analytic studies comparing digit span performances by Mexican adults to performance by adults from numerous other countries (e.g., Denmark, Poland, Italy, China, Venezuela), including South Africa (Ostrosky-Solis & Asucena, 2006). Ostrosky-Solis et al. (2006) have shown that literacy affects digit span, and that quality of education may contribute to the cross-cultural differences. Verbal subtests of the CMS, including Numbers, are substantially affected by parental level of education, with children of Hispanic and African-American heritage more affected than those with white parents (Cash, 2007).

2.4.2.3. Children's Memory Scales (CMS): Stories Subtest

2.4.2.3.1. Description of the CMS Stories Subtest

The CMS Stories subtest is a measure of Verbal Memory that assesses verbal recall of meaningful material that is embedded in a semantic context, i.e., a story format. Participants are required to reproduce as much information as they can remember from the stories immediately after hearing them, and then again after a filled delay.

2.4.2.3.2. Administration procedures for the CMS Stories Subtest

Test material consists of the stimuli (two stories), response forms, and a recording device. The examiner reads the stories with particular attention to clear enunciation, inserting brief pauses between sentences. The stories are read at a moderate pace, with the examiner taking care not to read too fast, as faster presentation rates have been shown to hinder recall (Shum, Murray, & Eadie, 1997).

Participants are required to recall as much information as possible immediately after the presentation of each story (i.e., Immediate Recall). After a delay of 20 to 30 minutes, during which non-verbal activities are performed, participants recall the stories again, without the examiner reading them first. After each recall attempt, participants are provided with an opportunity to add information to their initial effort. Two stories are tested, using the same procedures. Following the Delayed Recall trial, participants answer *yes* or *no* to factual questions about each of the stories (i.e., Recognition) and are encouraged to guess if they are unsure of the answers.

In this study I deviated from the standard protocol by testing all participants on the Stories E and F, rather than testing 12-year-olds on Stories C and D. This deviation was to facilitate direct score comparisons using identical test material. The original stories were not changed, except for the substitution of metric terminology: 1) In Story E, the words *pounds* and *miles* were substituted with units of measurements recognized in South Africa, i.e., *kilograms* and *kilometers*. Otherwise, administration procedures published in the test manual (Cohen, 1997) were followed exactly.

2.4.2.3.3. Scoring procedures for the CMS Stories Subtest

Story recall is recorded using an audio-taping device. Stories are transcribed verbatim and then scored according to the guidelines on the response forms. Two types of scores (viz., Story Units and Thematic Units) are calculated for each of the Immediate and Delayed Recall trials. The Story Unit scores reflect the ability to recall details of the story, while the Thematic Unit scores indicate to what extent the semantic content, or "gist", of the story is recalled (Talland & Ekdahl, 1959).

The examiner's recording forms provide examples of acceptable synonyms and variations of factual and semantic units, to facilitate ease and uniformity of scoring while allowing for subtle variations. One point is allocated for each Story Unit and each Thematic Unit recalled. Points are tallied to calculate total raw scores for Immediate and Delayed Recall, with maximum scores of 88 for Story Units and 13 for Thematic Units.

Correct yes/no responses for recognition are allocated 1 point, and tallied to form a raw subtest total (range = 0 to 30). Higher scores represent better functioning for all measures of the CMS Stories.

2.4.2.3.4. The utility of the CMS Stories Subtest

The CMS Stories assess verbal recall of meaningful material that is embedded in a semantic context. Story Unit and Thematic Unit recall performances have been demonstrated to be differentially affected by the location of brain injury (Cohen, 1997). For example, patients with damage to the left hemisphere tend to recall fewer details (Story Units), compared to patients with right-hemispheric dysfunction. The latter group tend to display difficulties recalling the "gist" (Thematic Units) of the stories, while the ability to recall Story Units remains relatively unimpaired (Delis, 1989). Performance on the Immediate and Delayed Recall trials tend to be strongly correlated to each other (Story Units = .88; Thematic Units = .84), and moderately correlated with Recognition (Immediate Recall of Story Units = .56; Delayed Recall of Story Units = .59; Cohen, 1997).

CMS Stories have been useful in detecting difficulties in learning new verbal material in numerous conditions, including epilepsy (Cohen, 1997); traumatic brain injury (Cohen, 1997; H. S. Levin et al., 1993; Yeates, Blumenstein, Patterson, & Delis, 1995); brain tumours (Cohen, 1997); and neurodevelopmental disorders such as ADHD (Cohen, 1997; Hynd & Willis, 1988), learning disorders (Cohen, 1997; Silver & Tipps, 1993), and speech and language impairments (Cohen, 1997).

2.4.2.3.5. Sociodemographic variables that influence the CMS Stories Subtest performance

The effects of age, sex, race, language, and quality of education have not been reported for the CMS Stories Subtest.

2.4.2.4. CLOX Test

2.4.2.4.1. Description of the CLOX Test

The CLOX test features two specific analog clock-drawing tasks designed by Royall et al. (1998). The first task (CLOX 1) is an unprompted clock drawing using a digital prompt, while the second task (CLOX 2) consists of a simple copy of a clock drawn by the examiner. CLOX 1 measures elements of executive functioning, whereas CLOX 2 measures visuospatial abilities (Royall et al., 1998; Royall, Espino, Polk, Palmer, & Markides, 2004; Strauss et al., 2006) .

2.4.2.4.2. Administration procedures for the CLOX Test

The CLOX test material consists of a sheet of paper with a decoy stimulus in the form of a circle printed on the one side, so that it is visible to the participant when completing CLOX 1. For CLOX 1, participants are instructed to draw a clock that says 1:45, and to set the hands and numbers on the face so that a child could read them. The instructions are repeated until the participant understands them. If the participant asks questions, the examiner repeats the instructions, but does not provide further information. The examiner may not say "quarter to two". The examiner carefully observes and records the placement order of the numbers (Royall et al., 1998).

For CLOX 2, the examiner exposes a blank sheet, and models a clock drawing set at 1:45, while the participant observes. The examiner draws the clock upside-down (so it is right-side up for the participant), and ensures that numbers 12, 6, 3, and 9 are placed first (before filling in the remaining numbers); that the hands are placed correctly and tipped by arrows; and that the hour hand is shorter than the minute hand. The participant then copies the modeled drawing(Royall et al., 1998).

2.4.2.4.3. Scoring procedures for the CLOX Test

The CLOX trials are each scored on a 15-point scale. Either 0 or 1 point is awarded for each criterion listed in Royall et al. (1998, p. 592). Points for each of the CLOX tasks are summed to yield Total scores ranging from 0 to 15. The CLOX Difference score is calculated by subtracting the CLOX 1 score from the CLOX 2 score.

2.4.2.4.4. The utility of the CLOX Test

The CLOX tests were developed to counteract some of the procedural and interpretative problems experienced with other clock-drawing tasks (CDTs). Examples of procedural problems include inconsistencies in stimuli (e.g., clock time settings), in prompt types, and in scoring protocols. The main interpretative problem with other CDTs involves the failure to isolate the executive control element from the clock drawing itself, which restricts the tests' capacity to differentiate between executive and visuo-constructional elements (A. Chan, Remington, Paskavitz, & Shea, 2008; Lezak et al., 2004; Royall et al., 1998).

The CLOX Difference score provides an indication of the relative influence of executive and visuo-spatial elements. The major benefit of the CLOX over other CDTs is its capacity to discriminate between executive impairment (CLOX 1), as distinct from non-executive visuoconstructional deficits (CLOX 2) (Royall et al., 1998; Royall et al., 2004; Strauss et al., 2006). The CLOX 1 task explains more variance in executive functioning than five other types of CDT investigated by Royall et al. (1999).

The CLOX 1 task involves goal setting, planning, selective attention, and self-monitoring, all of which are elements of executive control (Royall et al., 1998). Participants are challenged with initiating and maintaining goal-directed activity in the context of potentially distracting elements and with minimal guidance. They are responsible for choosing the form, size, position, and constructional elements of the clock, and then monitoring and correcting themselves in order to construct the appropriate end result.

The CLOX developers incorporated some potentially distracting elements in the test instructions and design in order to quantify the extent to which participants are able to resist responding to irrelevant cues. These include the potentially intrusive circle from the reverse side of the page, which tempts the participant to use it as a constructional framework; the use of the words "hands" and "face", which may trigger semantic intrusions; and the time-setting, which contains the number 45, which is not found on a traditional analog clock-face, so may elicit the drawing of a digital image, or hands drawn pointing towards either of (or both) the numbers 4 or 5 (Royall et al., 1998).

In contrast to CLOX 1, CLOX 2 is a simple copying task, and thus does not tap executive control skills; rather, it is a pure assessment of visuospatial construction abilities (Aase, Meyer, & Sagvolden, 2006; Royall et al., 1998; Strauss et al., 2006). For CDTs in general, performance on copy tasks (e.g., CLOX 2) tends to be better than on the drawing tasks (e.g., CLOX 1; Dilworth, Greenberg, & Kusche, 2004).

Although the CLOX tests and other CDTs have been employed primarily for dementia screening in older adults, their sensitivity to frontal lobe impairment may make them well suited to other contexts where executive functioning might be implicated. For example, children with ADHD perform worse than controls on CDTs (Kibby, Cohen, & Hynd, 2001).

2.4.2.4.5. Sociodemographic variables that influence CLOX Test performance

Age: Chan et al. (2008) found cohort effects in the CLOX tests when different prompt types were employed. Participants younger than 60 performed better with digital prompts “1:45”, whereas participants older than 70 performed better with analog prompts “quarter to two” (A. Chan et al., 2008). I employed the digital prompt (1:45) stipulated by Royall et al. (1998), which is appropriate for the age of our participants.

Although the CLOX test has not been used in the adolescent population, studies on other CDTs have demonstrated that performance improves between the ages of 6 and 12, stabilizes at 14, then remains constant until late adulthood (Bozikas et al., 2008).

Sex: The effects of sex on CLOX performance have not been reported.

Race, language, and quality of education: CDTs in general are considered to be less culturally and linguistically biased than many other cognitive tasks (Schulman, 2000). Performance has been shown to be consistent in a variety of different cultural contexts, for CDTs in the Greek population (Bozikas et al., 2008), and for the CLOX in Chinese Singaporean adults (Yap et al., 2007). Royall et al. (2003) validated the CLOX for use in older Hispanic adults. They found that acculturation had a negligible effect on performance. Although Spanish-speakers performed slightly worse than English-speakers, the effect was strongly mediated by level of education. The effects of quality of education on CLOX performance have not been reported, however.

2.4.2.5. Grooved Pegboard Test (GPT)

2.4.2.5.1. Description of the GPT

GPT equipment consists of 25 metal pegs with ridges along one side and a metal board with 25 slotted holes angled randomly in different directions so the participant has to remove the pegs from a tray and rotate them appropriately to fit them into the holes (Mitrushina et al., 2005). I used two versions of the GPT, viz., the original peg insertion version (GPT 1; C. G. Matthews & Klove, 1964), and a peg removal version (GPT 2; Bryden & Roy, 2005). In the latter test, the pegs are removed from the grooves in a filled pegboard and returned to the tray. The GPT measures aspects of motor performance, specifically fine motor hand-eye coordination, and psychomotor speed (Lezak et al., 2004; Mitrushina et al., 2005; Strauss et al., 2006).

2.4.2.5.2. Administration procedures for the GPT

GPT 1 forms part of several test batteries (Harley, Leuthold, Matthews, & Bergs, 1980; Lewis & Rennick, 1979; Russell & Starkey, 1993). I used the administration instructions and test equipment supplied by the Lafayette Company. Order of administration involved dominant hand peg insertion, then peg removal, followed by nondominant hand peg insertion, then peg removal.

Despite the relative simplicity of test instructions, variations in GPT1 administration procedures do exist, particularly with regard to practice trials, timing initiation, and quantity and order of trials (Lezak et al., 2004; Mitrushina et al., 2005; Strauss et al., 2006). For this study, the tester demonstrated peg insertion for one row, but no practice opportunities were provided for either GPT 1 or GPT 2. Timing began when the examiner gave the cue for the participant to begin, and ended when the final peg was inserted or removed.

Only one trial for each hand was administered for each GPT task, starting with the dominant hand. Peg insertion order was from left to right for each row for the right hand, and from right to left for the left hand. Participants were instructed to place the pegs in the board in the exact order and direction specified. Peg removal order was from the bottom of the board upwards by row, from right to left for the right hand, and from left to right for the left hand. Participants were instructed not to pick up more than one peg at a time, and were not allowed to use more than one hand at a time.

The tester instructed participants not to pick up pegs that they had dropped on the floor, but rather to replace the dropped peg with another one from the tray (which had spare pegs in excess of the 25 needed to complete the matrix). For GPT 1, a drop was defined as accidentally dropping the peg, as opposed to deliberately setting it down to manipulate or rotate it (Lezak et al., 2004); for GPT 2, a drop was defined as either dropping the peg as in GPT 1, or dropping it back into the hole in which it had been placed (Bryden & Roy, 1999, 2005). Timing was not interrupted when pegs were dropped.

2.4.2.5.3. Scoring procedures for the GPT

There is considerable variation in GPT 1 scoring procedures. Procedural differences include, for example, the inclusion and duration of time constraints (Russell & Starkey, 1993), and prorating or including drops into the total score (Trites, 1977). Contemporary practices (Heaton et al., 1986; Ruff & Parker, 1993), including the meta-analysis in Mitrushina et al. (2005), involve recording GPT scores as the time (in seconds) required to complete insertion of all pegs on each trial. Lower scores thus represent optimal performance.

I did not apply a time limit and obtained the following scores for the dominant and then the non-dominant hand: For GPT 1, peg insertion completion time (GPT 1 Time; i.e., the number of seconds taken to remove all 25 pegs from the tray and insert them into the holes) and number of drops (GPT 1 Drops); for GPT 2, peg removal completion time (GPT 2 Time), and number of drops (GPT 2 Drops). I also calculated intermanual differences for each GPT task (i.e., dominant hand minus nondominant hand completion time).

2.4.2.5.4. The utility of the GPT

The GPT has been widely acknowledged as more complex than other motor tasks (e.g., finger tapping and hand dynamometer tasks) in that it requires more task-specific cognitive effort (Bryden & Roy, 2005; Mitrushina et al., 2005; White et al., 2009). Bryden and Roy (1999, 2005) suggest that GPT 1 and GPT 2 are differentially sensitive to different components of manual dexterity, i.e., GPT 1 is more sensitive to visuomotor ability, whereas GPT 2 is more sensitive to motor speed.

Studies in adults have shown that GPT 1 is useful for the identification of lateralized impairment (Strauss et al., 2006) in localized neurological conditions such as brain tumors (Haaland, Cleeland, & Carr, 1977) and strokes (Haaland & Delaney, 1981), and in toxic exposure (Bleecker, Lindgren, & Ford, 1997; Grattan et al., 1998). Because these conditions also occur in adolescence, it is possible that the GPT may be useful in detecting psychomotor slowing in these contexts in the adolescent population.

GPT 1 performance has also been shown to be slower in children and adolescents with particular neurodevelopmental disorders, for example, fetal alcohol spectrum disorders (Aragon et al., 2008); autistic spectrum disorders (Hardan, Kilpatrick, Keshavan, & Minshew, 2003; Weimer, Schatz, Lincoln, Ballantyne, & Trauner, 2001); Williams syndrome (MacDonald & Roy, 1988); and ADHD (Meyer & Sagvolden, 2006). In psycho-educational contexts, GPT 1 has also been demonstrated to be sensitive to learning disabilities (Harnadek & Rourke, 1994; Rourke, Yanni, MacDonald, & Young, 1973).

Although intermanual discrepancies in GPT 1 have been used to indicate neurological impairment, such discrepancies are not uncommon in normal participants. For example, Bornstein et al. (1986) cite discrepancy rates as high as 20%; hence, clinicians are advised to corroborate these findings by using other tests of motor functioning to assist with clinical interpretation (Strauss et al., 2006).

2.4.2.5.5. Sociodemographic variables that influence GPT performance

Very few studies have used the GPT 2. Consequently, sociodemographic effects other than those of sex and hand dominance have not been reported.

Age: GPT 1 speed is affected by age, with performance improving throughout childhood (Rosselli et al., 2001) and stabilizing during adolescence (e.g., Trites, 1977).

Sex: Sex effects have not been shown for GPT 1 speed, but females tend to demonstrate greater intermanual differences than males (Rosselli et al., 2001; Thompson, Heaton, Matthews, & Grant, 1987). For GPT 2 speed, sex differences indicating female superiority have been demonstrated (Bryden & Roy, 2005).

Race, language and quality of education: Although GPT1 speed does not appear to be affected by level of education (e.g., R.A. Bornstein, 1985; Concha et al., 1995; Mitrushina et al., 2005), the impact of quality of education on performance has not been reported. Racial and linguistic differences have not been reported to affect GPT1 performance.

Hand preference and intermanual differences: The percentage of left-handed participants reported in studies tends to be low (e.g., 5-7.5%). Recommendations have been made to omit left-hand data from comparisons, or to report it separately to avoid handedness as a potential confound (Bryden & Roy, 2005; Mitrushina et al., 2005). GPT performance tends to be faster with the dominant hand by approximately (10%; Mitrushina et al., 2005). For example, intermanual differences of 8 seconds for the GPT1 and 1 second for the GPT2 have been shown (Bryden & Roy, 2005).

2.4.2.6. The Edinburgh Handedness Test (EHI)

Given the utility of the GPT as a measure of laterality, accurate identification of hand dominance (synonymously referred to as hand preference or handedness in the literature) is essential prior to testing (Mitrushina et al., 2005). Simplistic self-assessments of handedness, such as merely self-reporting which hand is used for writing, have been shown to underestimate tendencies toward use of the nondominant hand (Mitrushina et al., 2005; Oldfield, 1971).

The Edinburgh Handedness Inventory (EHI; Oldfield, 1971)was used to establish hand dominance in this study. The EHI is a self-rating scale on which participants rate their hand preference for 9 different activities (viz., writing, drawing, throwing, cutting with scissors, brushing teeth, using a knife to cut food, using a spoon, striking a match, and opening a box lid) and their foot preference for kicking a ball.

Scoring procedures for the EHI are as follows:

1) For the first 9 items, participants indicate whether they always use their left hand (score 2 left), usually use their left hand (score 1 left), have no preference (score 1 left and 1 right), usually use their right hand (1 right), or always use their right hand (2 right); and for the last item, their foot preference is indicated in a similar manner. Total scores for left and right dominance are tallied.
2) A cumulative total score is calculated by adding the total scores for the left and right dominance.
3) A difference score is calculated by subtracting the total left score from the total right score.

4) The EHI score is calculated by dividing the difference score by the cumulative total score, then multiplying by 100.
5) Hand dominance is then coded as either left-handed (scores below -40); ambidextrous (scores between -40 and 40); or right-handed (scores above 40).

2.4.2.7. Maj's Auditory Verbal Learning Test (MAVLT)

2.4.2.7.1. Description of the MAVLT

Maj et al.'s (1993) Auditory Verbal Learning Test (MAVLT) is a list-learning test used to assess aspects of verbal memory. It emulates the format and procedures for other Auditory Verbal Learning Tests (AVLT's), but uses a list of words that are considered to be familiar across different cultural contexts. I used the MAVLT word list and the commonly used administration format, which consists of five free recall trials (i.e., MAVLT 1 to MAVLT 5), an interference trial using a different set of words (MAVLT B), two post-interference recall trials (MAVLT Immediate and Delayed Recall), and a cued recognition trial (MAVLT Recognition; Lezak et al., 2004; Mitrushina et al., 2005; Strauss et al., 2006).

2.4.2.7.2. Administration procedures for the MAVLT

Due to the contributions of numerous authors, including Rey (1964), Taylor (1959), and Lezak (1983, 1995) numerous variations of various AVLT's exist, designed for use in particular clinical contexts (see Mitrushina et al., 2005; Schmidt, 1996; Strauss et al., 2006). Variations involve the following elements: 1) word list selection; 2) auditory or visual presentation; 3) rate of word presentation (ranging from 1 to 2 seconds); 4) number of recall trials (ranging from 3 to 6); 5) format of the recognition trial (e.g., between 30 and 50 words, presented either in a list, or embedded in a story); 6) duration of the interval between trials (ranging from 15 to 60 minutes); and 7) the extent of feedback to the participant regarding errors and the number of words recalled (Mitrushina et al., 2005).

For the MAVLT version used in this study, test materials consisted of 3 word lists, score sheets and an audio recording device. I used the MAVLT word lists (List A, List B, and recognition items) published in Strauss et al. (2006, p. 783), but note the typographical error for the 5th item of list A, which should read *plane*, not *place*. I also used the instructions described by Strauss et al. Strauss et al. (2006, p. 784, Fig. 10-29) verbatim for all trials, except for Recognition. The latter trial was presented orally, with participants answering *yes*/*no* to indicate whether they thought each of the 30 words was from the original list.

For MAVLT 1, the examiner instructs participants to listen carefully to the list of words, then to repeat as many words as possible, in any order, after presentation of the complete list. The examiner reads the words at the rate of one per second, and then records the answers verbatim in the order that the participant recalls them. In order to cope with fast responders, the examiner either uses abbreviations for the words, or a recording device. After testing, the examiner transcribes the words for scoring purposes, and deletes the recordings.

Once the participant indicates that s/he can not recall any more words, the examiner repeats the instructions, reminding participants to include the words recalled after the first presentation. This procedure is repeated a further 3 times, resulting in 5 learning trials, each with the same instructions. After the fifth trial, a new list (Trial B) is administered immediately. Then, without forewarning or re-presentation of a word list, participants are again required to recall the original word list, once immediately after Trial B, and then again approximately 30 minutes after the Immediate Recall trial. Non-verbal tasks are performed during the between-recall interval. Finally, the participants are required to recognize the original words from a list that also contains distractor words (Lezak et al., 2004). Throughout the task, participants are encouraged, but not provided with feedback about the number of words, content, accuracy, errors, or omissions.

2.4.2.7.3. Scoring procedures for the MAVLT

There is an enormous range of performance outcome variables (and alternative calculation methods) available for the AVLT's, each useful in delineating particular aspects of memory performance for specific research and clinical contexts. Details of these scores and how to interpret them are available in core texts (e.g., Geffen, Moar, O'Hanlon, Clark, & Geffen, 1990; Ivnik et al., 1990; Lezak et al., 2004; Mitrushina et al., 2005; Schmidt, 1996; Strauss et al., 2006). I selected the scores that are reported most frequently, using score calculation formulae used in studies that were useful for norm comparisons. The various outcome measures, calculation methods, and corresponding aspects of memory that are measured, are summarized in Table 4. For MAVLT Forgetting Rate and Error Scores, low scores represent better functioning, whereas for all other MAVLT scores, high scores represent better performance.

Table 4. *MAVLT: Outcome measures, score calculation formulae, and aspects of memory measured*

MAVLT Outcome Measure	Score Calculation Formula	Memory Aspect Measured
Trial 1	Total of correctly recalled words (range = 0 to 15)	Encoding under overload conditions
Trial 5		Final acquisition
Trial B		Distractor
Immediate Recall		Retention after a short delay
Delayed Recall		Retention after a long delay
Learning Rate	Trial 5 – Trial 1	Learning
Forgetting Rate	Trial 5 – Immediate Recall	Forgetting
Recognition	Total correct yes/no responses (range = 0 to 30)	Retrieval
Total Errors	Sum all repetitions and intrusions (for 5 acquisition trials and both postinterference recall trials)	Self-monitoring

2.4.2.7.4. The utility of the MAVLT

Although AVLT's such as Rey's original version (RAVLT) have been widely used in English and other languages, for example, Chinese, Dutch, Flemish, German, Hebrew and Spanish (e.g., Lezak et al., 2004; Mitrushina et al., 2005; Strauss et al., 2006), some of the items on that version (e.g., *turkey*, *ranger*, *curtain*) were not considered to be familiar to all cultures (Lezak et al., 2004; Maj et al., 1993). To adjust the word list to compensate for cultural unfamiliarity, Jinabhai et al. (2004) adapted the RAVLT for use in rural Zulu-speaking children with disadvantaged quality of education. They replaced the words *turkey* with *chicken*, and *ranger* with *herdboy*. Despite the word adaptations, scores for the South African children were considerably lower than those reported in international studies, implying cultural bias.

In response to the World Health Organization's (WHO) request for culturally-fair test development, Maj et al. (Maj et al., 1993), in collaboration with a research team from the University of California Los Angeles (UCLA), developed the MAVLT word list. The words were selected from a lexicon, compiled by Snodgrass and Vanderwart (1980), containing 250 universally familiar concepts. The words were clustered into categories (i.e., body parts, animals, tools, household objects, and vehicles), in an attempt to reduce cultural bias and to facilitate assessment of memory organizational strategies (Maj et al., 1993).

The cross-cultural utility of the MAVLT was confirmed in well-educated adolescents and young adults (mean age = 16 years) from different geographical locations, namely, Thai speakers from Bangkok; Lingala speakers from Kinshasa, Zaire; Italian speakers from Naples;

and German speakers from Munich (Maj et al., 1993). It is not known to what extent the cultural bias has been reduced in children, or in participants with fewer than 10 years of education. The RAVLT has been shown to be sensitive to memory impairment in a wide range of clinical and psychiatric conditions (Mitrushina et al., 2005; Strauss et al., 2006; Vakil, Blachstein, Rochberg, & Vardi, 2004), but it is not known whether these findings are generalizable to the MAVLT or to the adolescent population.

2.4.2.7.5. Sociodemographic variables that influence MAVLT performance

Information regarding sociodemographic influences on MAVLT performance has not been reported. Below I note some findings from RAVLT studies, which may or may not be transferable to the MAVLT.

Age: Age tends to affect RAVLT scores in a clustered, rather than a linear pattern, with 11- to 17-year-olds performing similarly, but obtaining better scores than 8- to 10-year-olds for Learning, Forgetting, and Recognition Rates. Immediate and Delayed Recall scores tend to improve gradually with age throughout adolescence (Vakil, Blachstein, & Sheinman, 1998).

Sex: A female advantage (of approximately 1 word per trial) has been shown for Recall, but not Recognition trials of the RAVLT, in children (V. Anderson & Lajoie, 1996).

Race, language, and quality of education

Cross-cultural comparisons have demonstrated that particular groups of South African children and adolescents perform poorly on the RAVLT in comparison with other published norms. For example, total scores (i.e., the sum of trials 1 to 5) for Zulu children with disadvantaged quality of education, from Kwa-Zulu Natal, were more than one SD lower than published norms based on US standardization samples (Jinabhai et al., 2004). Black-polyglot adolescents with disadvantaged quality of education, from urban and peri-urban regions in Gauteng, recalled a total of 10% fewer words than the normative US adolescent population on the RAVLT (Skuy et al., 2001).

Typical performance: Despite the numerous variations in protocols, a potentially useful clinical profile of performance, which is considered to be within normal parameters, has been described for interpreting RAVLT scores in adults (Lezak et al., 2004; Mitrushina et al., 2005). For example, an average of 6 or 7 words are recalled for RAVLT 1, and 12 or 13 for RAVLT 5, resulting in approximately 5 words being learned across trials (Lezak et al., 2004; Strauss et al., 2006). Forgetting rates tend to be between 1 and 2 words, and Immediate and Delayed Recall scores tend to be very similar. More than one error on RAVLT Recognition is considered to be rare. The number of words recalled at RAVLT 1 tends to be similar but not identical (i.e., within 1 or 2 points) to the maximum number of digits recalled in Digits Forward tasks (Lezak et al., 2004). Because the norms published for children use different word lists to the MAVLT, and sometimes employ non-standardized administration procedures (Strauss et al., 2006), it is difficult to ascertain the relevance of the abovementioned trends for children and adolescents.

2.4.2.8. Rey-Osterrieth Complex Figure Test (ROCFT)

2.4.2.8.1. Description of the ROCFT

Although the nomenclature used to describe Rey's (1964) complex figure varies, I use the term Rey-Osterrieth Complex Figure Test (ROCFT), in acknowledgment both to Rey, who devised the figure, and to Osterrieth, who standardized the administrative procedure and provided normative data for children (ages 4-15) and adults (ages 16-60; Meyers & Meyers, 1996; Strauss et al., 2006).

The ROCFT requires participants to first copy, then draw from memory, a complex figure consisting of various geometric components. The task measures various aspects of cognitive functioning, including: visuospatial construction ability; incidental visual memory; and the organizational element of executive functioning (Meyers & Meyers, 1996; Strauss et al., 2006). Although the completion time of the copy trial is usually recorded, it is unclear in the literature exactly what this measures. Meyers and Meyers' factor analyses of ROCFT subtests demonstrated that ROCFT Time is highly loaded on the graphomotor speed factor (Meyers & Meyers, 1996).

2.4.2.8.2. Administration procedures for the ROCFT

The ROCFT is widely used throughout the world (Camara, Nathan, & Puente, 2000; Rabin, Barr, & Burton, 2005), so it is not surprising to find considerable variation in administration and scoring procedures. Protocols vary according to number of trials, timing of between-trial intervals, imposition of time restrictions, the use of coloured pens, quantitative or qualitative scoring systems, lenient or strict application of scoring criteria, the use of alternative versions, for example, the Taylor Complex Figure (L. B. Taylor, 1979), and the use of a recognition trial (Duley et al., 1993; Lezak et al., 2004; Meyers & Meyers, 1996; Strauss et al., 2006).

In this study, I employed the most commonly used paradigm (Knight, Kaplan, & Ireland, 2003; Lezak et al., 2004; Strauss et al., 2006) that includes a copy trial (ROCFT Copy), an immediate recall trial (ROCFT Immediate Recall) and a delayed recall trial (ROCFT Delayed Recall) that is administered 30-45 minutes after the immediate recall.

The test materials consist of the ROCFT model drawing, three blank sheets of paper, a set of coloured pencils, an eraser, and a stopwatch. Prior to the publication of the manual published by Meyers and Meyers in 1996, the drawing had not been commercially available. The practice of photocopying various copies of the original drawing has resulted in distortions in the line thickness, size, and shapes of some of the elements, which compromises the validity and utility of the test (Meyers & Meyers, 1996).

Although it is possible to administer the ROCFT from the instructions and stimulus provided in texts by Knight (2003) or Strauss et al. (2006), I used the stimulus item from the manual by Meyers and Meyers (1996). Authors also debate whether to present the stimuli in landscape or portrait orientation. Although Ferraro et al. (2002) found that orientation of the figure (0, 90, 180, or 270 degrees) did not affect copy or recall scores on the ROCFT, I used portrait orientation based on evidence that participants who use landscape orientation tend to elongate their drawings (Meyers & Meyers, 1996).

Test instructions, as provided by Strauss et al. (2006), were given verbatim, and were repeated and simplified if necessary to ensure that the participant understood the tasks. Although participants were encouraged when they expressed difficulty with the tasks, they were not given additional cues or hints.

There are two methods used to obtain information about organizational strategy, viz. the coloured pen, and flowchart methods (Strauss et al., 2006). In the coloured pen method, participants use a series of coloured pen/cils and the examiner tracks the order in which the drawing units are completed by recording the order of the colours. In the flowchart method, the examiner replicates the participant’s drawing and indicates the order and number of the lines with a series of numbers and arrows. Although some authors strongly advocate one particular method, for example, Meyers and Meyers (1996) prefer the flowchart method), Ruffolo et al. (2001) found that neither the amount and quality of recorded information, nor the administration times, appear to be affected by the method used. Because of the lack of evidence indicating the superiority of one method over the other, I used the coloured pen method based on ease of administration and personal preference.

The stimulus was exposed to participants, who were instructed to copy the drawing as carefully as possible. The examiner handed the participants a series of differently coloured pencils as they completed copying particular sections of the drawing. The examiner recorded the order in which the pencils were given to clarify the sequence in which the drawing was completed for the purpose of allocating the organizational strategy scores (ROCFT OSS; P. Anderson, Anderson, & Garth, 2001). The Copy task was timed in seconds, from exposure of the stimulus until completion of the drawing. No time restrictions were imposed for any of the ROCFT tasks.

The Immediate and Delayed Recall trials of the ROCFT were not timed, and were drawn with a pencil. After the Copy had been completed, the stimulus was removed, and without forewarning, the participants were immediately asked to re-draw the design that they had just completed, from memory. Although between-recall intervals vary, differences between 0 to 3 minutes preceding the Immediate Recall, and within one hour (ranging from 15 to 60 minutes) preceding the Delayed Recall, appear to have a negligible effect on scores (Lezak et al., 2004; Meyers & Meyers, 1996; Strauss et al., 2006). I allowed a range of 30 to 45 minutes between the two recalls, and participants completed verbal tasks during the intervening period. Instructions for the Delayed Recall, i.e., to draw the figure again from memory, were given without forewarning.

2.4.2.8.3. Scoring procedures for the ROCFT

I recorded 5 scores for the ROCFT: Copy completion time (ROCFT Time) in seconds; a 7-point organizational strategy score (ROCFT OSS) for the copy; and 18-item, 36-point accuracy scores (yielding scores ranging from 0 to 36) for the Copy, Immediate Recall, and Delayed Recall trials. Except for the ROCFT Time, higher scores represent better functioning for all ROCFT scores.

The quantitative accuracy scoring system, originated by Osterrieth (1944), adapted by Taylor (1959), and widely distributed in neuropsychological texts (e.g., Mitrushina et al., 2005; Strauss et al., 2006), involves allocating a score ranging from 0 to 2 for accuracy and placement of each of the 18 configural elements. The scores for each of the 18 elements are tallied to form raw score totals for the ROCFT Copy, and for both Recall trials. Detailed descriptions of the 18 configural elements and the scoring criteria are available in Strauss et al. (2006, p. 812, Fig. 10-31).

Despite the explicit scoring criteria for the ROCFT, some investigators adopt the approach of scoring the copy trial more strictly than the recall trails (Lezak et al., 2004), which has resulted in score discrepancies of more than 4 points (Bennett-Levy, 1984). I scored the copy and recall tasks using the same level of stringency, using the guidelines by Meyers and Meyers (1996) , which allow for deviations of approximately 3mm and 6mm for accuracy and placements, respectively. Drawings were not penalized twice for the same error, and slight inaccuracies, such as skew lines and minor distortions, were ignored. Rotations of the stimulus card and response sheet were not penalized.

There are many scoring systems used to evaluate organizational strategy for the ROCFT, mostly based on the whether the participant draws the figure in a fragmented or conceptual manner, with higher scores being allocated to more conceptual organization (Lezak et al., 2004). I used the coloured pen method and the organizational strategy scoring system which was specifically designed for the assessment of children by P. Anderson et al. (2001). This system rates drawings on 7 levels of organizational strategy, with higher scores representing more effective organizational strategy as follows: (1) unrecognizable or substitution; (2) poor; (3) random; (4) piecemeal or fragmented; (5) part-configural; (6) conceptual; or (7) excellent. In this qualitative system, the sequence of elements drawn is evaluated in relation to the base rectangle and its vertical and horizontal midlines, which are regarded as the main configural elements. The scoring system is not contingent on the accuracy or orientation of the drawing (P. Anderson, Anderson, & Garth, 2001). The criteria for rating the level of organization according to the 7 levels are described in detail in P. Anderson et al. (2001, pp. 86-87).

2.4.2.8.4. The utility of the ROCFT

The ROCFT has been shown to discriminate between typically developing children and adolescents from those who suffer from a range of developmental and acquired disorders of the central nervous system. Visuospatial constructional deficits measured by the ROCFT Copy have been documented in children and adolescents who had sustained perinatal strokes (Akshoomoff, Feroleto, Doyle, & Stiles, 2002) and other cerebrovascular accidents (Rapport, Farchione, Dutra, Webster, & Charter, 1996), and adolescents with early-onset alcohol initiation (Squeglia, Spadoni, Infante, Myers, & Tapert, 2009). The Immediate Recall and Delayed Recall scores have helped to identify visuospatial memory deficits in children and adolescents with congenital syndromes (Poulton & Moffitt, 1995); low birth weight (H. G. Taylor, Minich, Klein, & Hack, 2004); Turner's syndrome (Romans, Roeltgen, Kushner, & Ross, 1997); traumatic brain injury (Garth, Anderson, & Wrennall, 1997; Strauss et al., 2006); temporal lobe lesions (J. K. Matthews, Anderson, & Anderson, 2001); post-irradiation treatment for leukemia (Lesnick, Ciesielski, Hart, Benzel, & Sanders, 1998; D. P. Waber et al., 2001); frontal lobe epilepsy (Hernandez et al., 2003); ADHD (Cahn & Marcotte, 1995; Seidman, Biederman, Faraone, Weber, & Ouellette, 1997); and learning and reading disabilities (Kirkwood, Weiler, Bernstein, Forbes, & Waber, 2001; D. Waber & Bernstein, 1995). Children with traumatic brain injury, particularly those with focal frontal lesions, tend to produce poorly organized drawings, performing poorly on ROCFT OSS scores (Garth et al., 1997; Mathews, Anderson, & Anderson, 2001).

2.4.2.8.5. Sociodemographic variables that influence ROCFT performance

Age: In their predominantly white American sample, Meyers and Meyers (1996) found a linear relationship between age and performance on ROCFT Time, Copy, Immediate Recall, and Delayed Recall measures. A steep developmental trajectory was demonstrated, showing improved performance between the ages of 6 and 11, stabilization between the ages of 12 and 16, and near-perfect scores at 17 years.

P. Anderson et al. (2001) also showed that ROCFT OSS is related to age, with considerable variation occurring in younger children (between 7 and 10 years). By the age of 11, fewer children use poor or fragmented strategies, and more use part-configural or conceptual strategies. Surprisingly, younger children (i.e., 10- to 11-year-olds) in the Anderson study used more efficient organization strategies than 12- to 13-year-olds, who used a larger percentage of piecemeal (less efficient) strategies. These findings are not unusual in studies of executive functioning in children, which tend to demonstrate "gappiness", that is, abrupt increases and decreases in efficiency (P. Anderson, Anderson, & Garth, 2001; Kirk, 1985), thereby suggesting that organizational abilities continue to develop during transitional developmental phases such as adolescence.

Age and culture: In a mixed ethnic sample of children from New Zealand who were competent in English (Fernando, Chard, Butcher, & McKay, 2003), steady increases in accuracy scores were demonstrated for ROCFT Copy and Delayed Recall between the ages of 7 and 10, and greater consistency in scores after the age of 12. Fernando et al. (2003), compared the performance of their sample with the American sample used in Meyers and Meyers (1996), and found significant differences in scores between some age groups. For example, for ROCFT Copy, 12- to 13-year-olds from New Zealand attained lower accuracy scores than Americans of the same age, but there was no difference in the scores of 14- to 15-year-olds. Furthermore, with regard to Delayed Recall, there were no differences in scores between the two samples of 12- to 14-year-olds, but 15-year-old New Zealanders scored, on average, 4 points higher than 15-year-old Americans.

Sex: No sex differences have been found in any ROCFT scores in children or adolescents (Fernando et al., 2003; Meyers & Meyers, 1996).

Race: No differences on ROCFT copy or recall tasks were found between children resident in New Zealand who belonged to different ethnic groups, namely, Paheka, Maori, Pacific Island or other (Fernando et al., 2003). In South Africa, however, cross-cultural differences were shown between the USA norm group and black-polyglot adolescents from Gauteng. Differences exceeded 1 SD on the Copy trial, and between 1 and 2 SD's on a single recall trial after 30-minutes, with inner-city adolescents attaining lower recall scores than their age-matched peers in peri-urban (township) regions (Skuy et al., 2001).

Typical performance: Strauss et al. (2006) alert clinicians to the potential pitfalls of using interpretive categories for the ROCFT Copy scores: because such scores are not usually normally distributed, interpreting high scores as *superior* is meaningless. However, low scores, and in particular those below a particular cut-off point, should be considered to be clinically significant. It is also advisable to compare copy and recall scores to aid clinical interpretation (Loring, Martin, Meador, & Lee, 1990; Strauss et al., 2006). For example, different guidelines for interpreting retrieval, storage, encoding, and attention difficulties are provided for different profiles of ROCFT scores (e.g. Meyers & Volbrecht, 1998).

ROCFT Immediate Recall and Delayed Recall scores rarely differ by more than 2 points (e.g., Berry, Allen, & Schmitt, 1991; Heinrichs & Bury, 1991), and decline more than 2 points between recall trials is regarded as clinically significant (Strauss et al., 2006). The ROCFT Organizational Strategy score tends to correlate highly with Copy, Immediate Recall, and Delayed Recall scores: Drawings with configural (rather than fragmented) organization are typically associated with higher copy and recall accuracy scores (P. Anderson, Anderson, & Garth, 2001).

2.4.2.9. Stroop Color-Word Test – Golden Version (SCWT)

2.4.2.9.1. Description of the SCWT

The SCWT requires participants to read as many items as possible within a 45-second time limit. There are three separate tasks, presented on three separate pages: 1) the Word task, where the participant reads the names of three colours printed in black ink; 2) the Color task, which involves naming the colours printed in coloured "X's"; and 3) the Color-Word task, which requires reading the colours in which the words are printed, ignoring the printed words (Strauss et al., 2006). The Word task reflects reading speed; the Color task assesses the ability to distinguish and name three colours (Golden & Freshwater, 2002); and the Color-Word task specifically measures the ability to selectively attend to one stimulus while guarding against interference from another (Lezak et al., 2004; MacLeod, 1991). This latter selective attentional ability is an aspect of executive control, viz. response inhibition, which "assesses the ease with which a person can maintain a goal in mind and suppress a habitual response in favor of a less familiar one" (Strauss et al., 2006, p. 477).

2.4.2.9.2. Administration procedures for the SCWT

There are numerous versions of the Stroop tests, which vary according to the number of colours used, number of items per trial, number of trials, format for presenting the colours, presentation of items by row or column, and scoring methods (Golden & Freshwater, 2002; Lezak et al., 2004). Although 15-year-olds are classified as "adults" in the Golden variants of the Stroop test (e.g., Golden, 1978; Golden & Freshwater, 2002), I used the child version (5 to 14 years) by Golden, Freshwater, and Golden (Golden et al., 2003), for methodological uniformity. The test material for the child and adult versions is identical.

The Golden version employs 3 colours (red, green, and blue), and 100 items per page (presented in 5 columns of 20 items each). On each page, the items are read by the participant down the columns beginning on the left side of the page. Although the presentation of the format appears not to affect normal participants, those with brain injuries have been shown to lose their place more frequently when reading the stimuli across rows (Silverstein & Franken, 1965). Consequently, in the Golden version, participants read the stimuli down the columns.

The test material consists of 3 stimulus cards printed on a white background, and a stopwatch. The words *red*, *green*, and *blue* are the stimulus items, printed in black ink, on the Word Page. On the Color Page, the three colours are printed as a series of four capitalized letter X's, so that the colour intensity of the stimuli on the Color and the Color-Word Pages are more uniform than in previous versions (Stroop, 1935), where the solid blocks of colour on the Color Page were more intense than the Color-Word items, where the letters are interspersed with the white background of the page (Golden & Freshwater, 2002). The Color-Word page contains items wherein the words and ink colours are incongruent (e.g., the word *red* is printed in green ink).

For all three pages, the stimuli were designed by the developers so that no word or colour was allowed to follow itself in a column, and no colour on the Color Page was allowed to match the corresponding item on the Word Page. The Color-Word Page was constructed by blending the Word and Color pages to form the corresponding Color-Word Page items (Golden & Freshwater, 2002; Golden et al., 2003). For example, the first item on the Word Page is *red*, the first item on Color Page is *blue*, so the first item on Color Page is the word *red* printed in *blue* ink.

In this study, the test was administered in a manner identical to that prescribed in the manual (Golden et al., 2003). The following activities were therefore disallowed: rotations of the stimulus card by more than 45 degrees; lifting of the stimulus item; and covering of the pages. Participants were allowed to track the items with a finger. They were also allowed to re-start the page if they began the wrong task, or lost their place (Golden et al., 2003). Timing began once participants were instructed to begin the tasks, and ended at 45 seconds. Each error was pointed out immediately and participants had to correct the error before proceeding to the next item.

2.4.2.9.3. Scoring procedures for the SCWT

In order to reduce examiner error in scoring the SCWT, during which the participants often respond very quickly, I created a set of scoring templates. On the templates, the correct responses are printed in the same matrix format as the stimuli, allowing the examiner to check the items and to track errors. In the literature, there are two different scoring methods for Stroop tasks, where the score represents either (1) the time to complete 100 items, or (2) the number of items correctly named within a given time limit. In the Golden version, the latter system is used, with a time limit of 45 seconds. The authors preferred this system because the limited time interval tends to be less frustrating to impaired and younger participants (Golden & Freshwater, 2002; Golden et al., 2003).

Although error scores are sometimes reported for qualitative purposes, I used the three standard scores (i.e., total items completed correctly, excluding errors, in 45 seconds for each trial), and an Interference score. Golden et al. employed different techniques for their calculations of Interference in their adult and child versions. I used the simpler method (i.e. the Color total is subtracted from the Color-Word Total) recommended by Chafetz and Matthews (e.g., 2004), which Golden et al. (2003) use in the child version, in which the Color Total is subtracted from the Color-Word Total.

The term "interference" is used ambiguously in the literature; it refers either to the Color-Word score or to the Interference score (Alansari & Baroun, 2004; Chafetz & Matthews, 2004). I refer to the Color-Word score as a measure of response inhibition and the Interference score to indicate the vulnerability to interference. For example, a participant who struggles to inhibit responses and is susceptible to the high levels of interference effect would attain a low Color-Word score and a high Interference raw score compared to someone with better cognitive control or flexibility, who would be able to perform the task with minimal interference, thus achieving high Color-Word and low Interference scores.

2.4.2.9.4. The utility of the SCWT

The "Color-word interference effect" (Golden & Freshwater, 2002, p. 1), which describes the phenomena whereby participants (a) take a substantially longer time to name printed segments of colour than they do to read the words naming the colours, and (b) take even longer to process words printed in incongruent colours, was first documented by Cattell (1886), then refined and formalized into test format by Stroop (1935). There are currently many variants of the basic Stroop test, which aims to produce and assess the phenomena described above (Golden & Freshwater, 2002; Mitrushina et al., 2005; Strauss et al., 2006). Golden's versions (e.g., Golden & Freshwater, 2002; Golden et al., 2003) have emerged as some of the most frequently used protocols (Mitrushina et al., 2005; Strauss et al., 2006).

Lezak (2004) reports that the Stroop test is unpleasant for participants, particularly those with concentration difficulties. She thus administers the test last, and explains to the participant that the test is difficult, but provides useful information, in an attempt to ameliorate against the "pain" of the task (Lezak et al., 2004, p. 367). Our field observations contradict Lezak's experience. Despite acknowledging its difficulty, the participants tested in our study indicated that the tasks were enjoyable and entertaining (possibly because they did not have difficulty concentrating). Because our participants were either healthy controls or adolescents with alcohol dependence (who performed poorly on the SCWT, but still enjoyed it), our observations may be restricted to characteristics unique to our particular test sample, and it would be advisable to heed Lezak's advice when testing adolescents with types of pathology that may indeed make the task unpalatable.

Poor performance on the SCWT has been shown to be sensitive to a range of clinical conditions in children and adolescents, including traumatic brain injuries (Chadwick, Rutter, Shaffer, & Shrout, 1981; Shum, McFarland, & Bain, 1990), particularly those involving the frontal lobes (Boucugnani & Jones, 1989; Homack & Riccio, 2004); Turner's syndrome (Temple, Carney, & Mullarkey, 1996); learning disorders (Lazarus, Ludwig, & Aberson, 1984); and disruptive behavioural disorders (Lavoie & Charlebois, 1994). Although meta-analyses demonstrate inconsistent findings regarding SCWT performance in participants with ADHD (e.g., Homack & Riccio, 2004; Schwartz & Verhaeghen, 2008), individual studies and one meta-analysis, in which studies using discrepant methods for the Golden versions were removed from the analyses, provided strong evidence to support the SCWT's sensitivity to ADHD (Lansbergen, Kenemans, & van Engeland, 2007).

2.4.2.9.5. Sociodemographic variables that influence SCWT performance

Age and level of education: In Golden et al.'s (2003) standardization sample of children and adolescents, age and education were highly correlated with each other, and associated with all SCWT outcome scores. The age/education trajectory shows that all scores improved from the third grade throughout childhood, but at differential rates, with steep inclines in Word and Color scores before adolescence, and gradual improvement in Color-Word scores throughout the age range, but slowing after the age of 10 (Golden et al., 2003).

Sex: Although the normative sample was weighted towards females, no sex differences were found in any of the SCWT scores (Golden et al., 2003).

Race, language, and quality of education: On a different version of the SCWT to the one used in this study, black-polyglot adolescents in Gauteng achieved lower scores on all three tasks, in comparison with norms from the USA (Skuy et al., 2001).

2.4.2.10. Tower of London (ToL)

2.4.2.10.1. Description of the ToL

The Tower of London (ToL), a test of executive planning and problem-solving, was developed by Shallice (1982) for use in adults with frontal lobe damage. Since then, many variants of the ToL have been created (Baker, Segalowitz, & Ferlisi, 2001; Berg, Byrd, McNamara, & Case, 2010; Bull, Epsy, & Senn, 2004; Gilhooly, Wynn, Phillips, Logie, & Della Sala, 2002; Newman & Pittman, 2007; Pulos & Denzine, 2005; Raizner, Song, & Levin, 2002). I used the version that was modified and standardized by Culberston and Zillmer (2001) for use in adults and children in 2001. This version of the ToL involves 10 progressively more difficult trials in which participants reorganize 3 coloured beads on 3 vertical pegs on a tower-like structure, to emulate the patterns on the examiner's model, using the minimum amount of moves possible, within the enforced rules (Culbertson & Zillmer, 2001; Le Gall et al., 1990).

2.4.2.10.2. Administration procedures for the ToL

ToL testing equipment consists of two tower-structure boards, two sets of coloured beads, test stimuli, score sheets, and a stopwatch. Different practice trials and problem scenarios are available for children and adolescents (aged 7 to 15 years) and adults (aged 16 years and over; Culbertson & Zillmer, 2001). I used the test format, instructions, and rules,as published in Culbertson and Zillmer's (2001) ToL manual for children and adolescents.

If necessary, demonstration trials were repeated until the participant understood them, and practice trials, if incorrect, were repeated until the participants completed them correctly. All 10 test trials were administered, and problems that were unsolved after 120 seconds were discontinued (after being assigned a maximum move score of 20). Problems completed in a time period between 60 and 120 seconds were recorded as Time Violations. Rule Violations (i.e., overloading the capacity of the pegs, e.g., placing two beads on a peg designed to hold one peg; and moving two or more beads simultaneously) were pointed out immediately. The examiner moved the beads back to the locations that they occupied before the error was committed.

Timing continued during the corrections, and corrected moves were included in the move counts. Timing began as soon as the problem was exposed and ended once the final correct bead was placed at the top of the relevant peg. If participants were visibly frustrated or expressed the desire to stop a trial or to re-start it, they were encouraged to continue until the problem was solved. Although examiners provided verbal encouragement, no direct feedback regarding performance was given.

2.4.2.10.3. Scoring procedures for the ToL

A *move* is defined as the removal of a bead from a peg and subsequent placement onto the same or a different peg (Culbertson & Zillmer, 2001, p. 14). The ToL yields 7 possible outcome scores, all reflecting subtly different aspects of executive planning and problem-solving. Studies tend to report a single score (e.g., Berg et al., 2010; Newman & Pittman, 2007) , or a composite score (e.g., Murji & DeLuca, 1998). I used the Total Correct score as the primary measure of executive problem-solving. I also used Rule Violations, Time Violations, and Total Problem-solving Time as supplementary measures of self-monitoring, processing speed, and efficiency of problem-solving, respectively as recommended by other authors (e.g., Berg et al., 2010; Newman & Pittman, 2007; Unterrainer et al., 2004).

The ToL outcome scores mentioned above are calculated as follows:

- Total Correct: For each of the 10 problems, the minimum move count (i.e., the least number of moves possible to complete the task correctly, which ranges from 3 to 7) is subtracted from the achieved move count (i.e., the actual amount of moves taken by the participant to complete the task correctly) to calculate the Move Score. Correct Scores are Move Scores of 0. The Total Correct Score is the number of items for which Correct Scores are achieved (range = 0 to 10).
- Rule Violations: Each time the participant exceeds the capacity of a peg, or moves two pegs simultaneously, constitutes a Rule Violation. All Rule Violations committed during the 10 trials are tallied to create a total Rule Violation score. Although there is no theoretical upper limit, most children and adolescents do not commit more than 3 Rule Violations across the 10 ToL problems;
- Time Violations: This score consists of the total number of ToL items which are completed between 60 and 120 seconds (range = 0 to 10);
- Total Problem-Solving Time: The total task completion times for each problem are summed to reflect the entire time taken to complete the ToL test. Time scores for each item cannot exceed 120 seconds, so Total Problem-solving Time scores range from 10-1200 seconds.

2.4.2.10.4. The utility of the ToL

In addition to being particularly well tolerated by adolescents, perhaps because of its puzzle- or game-like format, the ToL is renowned for being able to identify executive planning disorders effectively (Culbertson & Zillmer, 2001; Lezak et al., 2004) in various conditions affecting adolescents, including autism (Hughes, Russell, & Robbins, 1994; Ozonoff, Pennington, & Rogers, 1991); frontal lobe injuries (H. S. Levin et al., 1994); closed head injuries (Raizner et al., 2002); ADHD (Cornoldi, Barbieri, Gaiani, & Zocchi, 1999; Culbertson & Zillmer, 2001; Pennington & Ozonoff, 1996); and learning disabilities, specifically arithmetic difficulties (Sikora, Haley, Edwards, & Butler, 2002).

2.4.2.10.5. Sociodemographic variables that influence ToL performance

Age: There is a linear relationship between age and ToL performance, with evidence of a gradual increase in proficiency and reduction in Rule Violations between the ages of 7 and 15 (e.g., P. Anderson, Anderson, & Lajoie, 1996; Krikorian, Bartok, & Gay, 1994). Specifically, 10- to 12-year-olds are able to complete ToL problems in fewer moves and with fewer violations than younger children. The level of sophistication in problem-solving is enhanced in 13- to 14-year-olds, who, in addition to making fewer moves and errors, tend to utilize means-end planning strategies effectively. For example, qualitative observations show that the older children contemplate the tasks before initiating them, demonstrating the ability to pre-contemplate the end result and maintain the goal in mind during the task, compared to younger children, who tend to initiate the task immediately, with more emphasis on the concrete here-and-now (Culbertson & Zillmer, 2001).

Sex: In the ToL standardization sample, no sex differences were found on any of the ToL measures (Culbertson & Zillmer, 2001).

The effects of race, language and quality of education on the ToL have not been reported for adolescents.

2.4.2.11. Verbal Fluency Tests – Phonemic and Semantic

2.4.2.11.1. Description of Verbal Fluency Tests

Verbal Fluency tests require participants to produce as many words as possible within time limits and under specified search conditions. Two types of Verbal Fluency are typically tested:

Phonemic (or letter) Fluency, in which participants generate words beginning with particular letters; and Semantic (or category) Fluency, in which participants generate words belonging to a particular category. In this study, Phonemic Fluency was assessed with the letters L, B, and S, and Semantic Fluency with the category of animals. All tasks had to be completed within a time limit of 60 seconds. Verbal Fluency tests measure verbal generativity, which is an important aspect of executive functioning involving cognitive organization, initiation, maintenance and effort (Alvarez & Emory, 2006; Kockler & Stanford, 2008; Lezak et al., 2004).

2.4.2.11.2. Administration procedures for Verbal Fluency tests

Verbal Fluency test materials included response sheets, an audio-recording device, and a stopwatch. I used the instructions and administration procedures recommended by Strauss et al. (2006). Demonstration and practice opportunities (letter D for Phonemic Fluency, and kitchen items for Semantic Fluency) were given to participants to ensure that they understood the rules.

Rule Violations included the use of proper nouns, and morphological variations on a previously named word (e.g., *larger* and *largest* are inadmissible after naming the word *large*). Slang items, recognizable words borrowed from other languages, foreign words which were part of standard language usage, and homophones (i.e., different word meanings with the same pronunciation, e.g., *son* and *sun*) were credited. Extinct or mythical animals (e.g., *dodo*, *dinosaur*, and *unicorn*) and animal categories or specific subtypes (e.g., *bird*, *dove*, and *eagle*) were admissible, but animal names (e.g., *Spot*, *Garfield*) were not. Feedback about errors was not provided to participants. Timing commenced when the examiner instructed the participant to begin each task. Participants' responses were recorded with an electronic recording device. The recordings were erased as soon as the examiner had transcribed the responses verbatim onto the answer sheet.

2.4.2.11.3. Scoring procedures for Verbal Fluency tests

Responses were marked as correct, or recorded as erroneous (Phonemic Fluency Errors and Semantic Fluency Errors). Error types included Repetitions (previously used words), Rule Violations (proper nouns or extensions of previously used words), or Set-Loss Errors (e.g., using a word that begins with another letter, or naming something that is not defined by the specified category). Incorrect responses that were corrected immediately and spontaneously by participants were not recorded as errors. Correct responses were tallied for each of the three letters and summed to form a total Phonemic Fluency Score. The Semantic Fluency Total included all the correctly named animals. Errors were tallied as qualitative indications of self-monitoring. The number of responses presented in a language other than the test language was recorded. For both Verbal Fluency tests, better functioning was represented by the generation of more words, and the commission of fewer errors.

2.4.2.11.4. The utility of Verbal Fluency Tests

The two forms of Verbal Fluency are not equally difficult and have slightly different neuro-anatomical correlates (Billingsley et al., 2004; Klumpp & Deldin, 2010). Semantic Fluency appears to be easier than Phonemic Fluency, reputedly because retrieval of items in one semantic category requires exploration of fewer subcategories than is required to retrieve words initiated with letters (Lezak et al., 2004; Riva, Nichelli, & Devoti, 2000). Phonemic Fluency has been shown to place greater demands on strategic organization and response inhibition, thus requiring more cognitive effort than Semantic Fluency (Strauss et al., 2006), and resulting in more words generated by adults in the animal category (18 to 20 words) than per letter (12 to 16 words; Lezak et al., 2004). The corresponding neuro-anatomic activation areas during the two tasks also differ. Although both types of Verbal Fluency depend heavily on intact frontal lobe functioning, Phonemic Fluency also requires intact temporal region function (Strauss et al., 2006). It is thus inadvisable to use the two types of fluency interchangeably, or to use normative data from the one type to make inferences about the other.

Protocols regarding letter and category selection have varied considerably in the six decades of Verbal Fluency testing. For Phonemic Fluency, the letters F, A, and S (which were used in Benton's (1968) version of the test) have been used extensively, resulting in the nickname "FAS" test (Mitrushina et al., 2005). Although Benton and Hamsher (1969) selected two letter sets (CFL and PRW) for use in their *Controlled Oral Word Association (Test)*, the acronym *COWA(T)* is often used as a looser, more generic term to refer to Phonemic Fluency tests, regardless of which letters are used (Lezak et al., 2004).

Even in English monolingual studies, preferences for letter sets vary widely. Some researchers prefer FAS (e.g., Egeland, Landro, Tjemsland, & Walbaekken, 2006; Troyer, 2000), while others use CFL and/or PRW (e.g., Ross, Furr, Carter, & Weinberg, 2006). The aforementioned letters, as well as letters B, D, H, M, N, and T have been used individually, or in sets of three or two letters, such as PS (Ratcliff et al., 1998) or TN (Gauthier, Duyme, Zanca, & Capron, 2009). Large meta-analytic studies generally conclude that Phonemic Fluency performance varies significantly according to which letter/s are used. For example, the set CFL is considerably more difficult for English speakers than FAS (D. Barry, Bates, & Labouvie, 2008), underscoring the necessity to adopt a principled approach to letter selection even in monolingual English studies. I used the letters LBS, based on the results of a principled and empirical letter selection method (described in section 2.5).

For Semantic Fluency, categories are often used individually, sometimes in sets, and less often in combinations requiring participants to alternate between two categories. Examples of categories include *fruit* and/or *vegetables*, *food*, *clothing*, *supermarket items*, *first names*, *jobs*, *musical instruments* and *actions/verbs* (Lezak et al., 2004; Strauss et al., 2006). I used a single category, viz., *animals,* which is most frequently used in the literature (Lezak et al., 2004; Strauss et al., 2006). The *animal* category is popular because performance on it is relatively consistent across languages, countries, including South Africa (Nell, 2000), and age groups (Ardila, Ostrosky-Solis, & Bernal, 2006).

Verbal Fluency tests have been successfully adapted for cross-cultural/cross-lingual use in a variety of international settings, either as individual tests, or as part of broader neuropsychological assessment batteries (Strauss et al., 2006). Verbal Fluency has been widely used to test adults in many languages and cultures, for example, Greek (Kosmidis, Vlahou, Panagiotaki, & Kiosseoglou, 2004); Dutch (Van der Elst, Van Boxtel, Van Breukelen, & Jolles, 2006); Flemish (Lannoo & Vingerhoets, 1997); Spanish (Acevedo et al., 2000; Chiu et al., 1997; Gollan, Montoya, & Werner, 2002; Kempler, Teng, Dick, Taussig, & Davis, 1998; Ostrosky-Solis, Gutierrez, Flores, & Ardila, 2007); Cantonese (A. S. Chan & Poon, 1999; Chiu et al., 1997; Kempler et al., 1998); Hebrew (Axelrod, Tomer, Fisher, & Aharon-Peretz, 2001); Vietnamese (Kempler et al., 1998); Swedish (Tallberg, Ivachova, Jones Tinghag, & Ostberg, 2008); and Norwegian (Rodriguez-Aranda, 2003).

Research on the use of Verbal Fluency tests in children and adolescents is less prolific, but does exist, for example for Afrikaans-speaking South African children (Kodituwakku et al., 2006); Italian children (Riva et al., 2000); Brazilian children (Dellatolas et al., 2003); Norwegian adolescents (Landro & Ueland, 2008); and Mexican children and adolescents (Matute, Rosselli, Ardila, & Morales, 2004).

Valuable insights have been gained from cross-cultural studies of Verbal Fluency. Kempler et al. (1998) for example, demonstrated that Vietnamese outperform Spanish speakers on the *animal* semantic category. The difference in performance is probably due to the fact that Vietnamese animal names are mainly monosyllabic, whereas Spanish animal names are bi-, or tri-syllabic. It is thus important to conduct linguistic analyses, including syllable counts, before making inferences about cross-cultural differences in performance. Oberg and Ramírez (2006), who directly compared Phonemic Fluency performance in Danish, English, Spanish, and Hebrew-speaking adults with more than 10 years of education, found that performance was similar across languages and cultures, as long as letter frequencies and education levels were considered in the comparisons.

Other authors (e.g., Kosmidis et al., 2004) recommend selecting letters that are least contingent on education. For example, in Spanish, *A* words are often preceded by a silent *ha* (Strutt, 2010). This finding is transferable to the South African context: For example, the letter C may be unsuitable in English because this letter is pronounced differently in word-initial position in different words (compare, for example, *cell* and *cake*). Similarly, the letter F might be unsuitable in Afrikaans because when the *f*-sound occurs in word-initial position, it is sometimes written with an F and sometimes with a V. For example, *fiets* (*bike*) and *voete* (feet) both start with an *f*-sound, increasing the likelihood of less-educated adolescents committing set-loss errors (in the form of spelling errors, rather than due to difficulties maintaining set).

Verbal Fluency tests provide clinically informative measures of executive dysfunction in numerous psychiatric and neurological conditions e.g., in adults with diffuse and focal brain injury (Henry & Crawford, 2004), specifically pre-frontal and frontal lobe lesions (Szatkowska, Grabowska, & Szymanska, 2000), and in adults with left-sided lesions (Billingsley et al., 2004); in South African young adult Zulu-speakers with traumatic brain injury (Sperinck & De Picciotto, 1999); in adults and adolescents with schizophrenia spectrum disorders (Bonilha et al., 2008; Landro & Ueland, 2008); and in South African Afrikaans-speaking children with fetal alcohol spectrum disorders (Kodituwakku et al., 2006).

2.4.2.11.5. Sociodemographic variables that influence Verbal Fluency Test performance

Age and level of education: Age and education effects have been widely reported in Verbal Fluency tests, with different trends in Phonemic and Semantic Fluency. Phonemic Fluency improves during childhood, with a dramatic increase in the first 2 years of formal education, and a peak in the third decade. Semantic Fluency improves gradually during childhood, and peaks sometime between adolescence and early adulthood. Semantic Fluency tends to decline more rapidly than Phonemic Fluency as age increases (Mitrushina et al., 2005; Strauss et al., 2006). Although very little data is available for participants with fewer than 9 years of education, it is clear that Verbal Fluency performance correlates positively with years of education (D. Barry et al., 2008). Although some inconsistency is seen, education tends to contribute most to the variance in Phonemic Fluency, while age is more influential in Semantic Fluency (Mitrushina et al., 2005; Strauss et al., 2006).

Sex: There is little consistent evidence of sex differences in Verbal Fluency tasks (e.g., D. Barry et al., 2008; Mitrushina et al., 2005; Strauss et al., 2006), although some adolescent samples have demonstrated a female advantage (e.g., Barr, 2003).

Race, language and quality of education: Cross-lingual differences have been widely reported in both Verbal Fluency categories. Bilingualism has shown to impact negatively on performance, with more interference associated with Semantic than Phonemic Fluency, even when participants are permitted to respond in both languages (Kempler et al., 1998; Mitrushina et al., 2005; Portocarrero, Burright, & Donovick, 2007; Rosselli et al., 2002; Strauss et al., 2006). Education effects on Verbal Fluency tend to interact with intelligence and reading ability (Mitrushina et al., 2005; Steinberg, Bieliauskas, Smith, Ivnik, & Malec, 2005; Strauss et al., 2006). Reading ability and speed appear to be more strongly associated with Phonemic than Semantic Fluency (Rodriguez-Aranda, 2003; Strauss et al., 2006).

Race and geographical location have an influence on Verbal Fluency performance, but these factors tend to be moderated by socioeconomic status, acculturation, and quality of education, making straight-forward inferences difficult (Fillenbaum, Heyman, Huber, Ganguli, & Unverzagt, 2001; Lezak et al., 2004; Mitrushina et al., 2005; Rosselli et al., 2002; Strauss et al., 2006). In South African studies, Zulu-speaking young adults performed worse on a Semantic Fluency task than English speakers (Sperinck & De Picciotto, 1999); and adolescents with disadvantaged quality of education performed worse on both Phonemic and Semantic Fluency tasks than age-matched participants with advantaged education (Cavé & Grieve, 2009).

2.4.2.12. Wechsler Abbreviated Scale of Intelligence (WASI)

2.4.2.12.1. Description of the WASI

The Wechsler Abbreviated Scale of Intelligence (WASI; Psychological Corporation, 1999) is a brief intelligence test (15-30 minutes), which, in comparison to its lengthy Wechsler counterparts, allows clinicians to spend more time on other neuropsychological tests. It is also popular because it incorporates both verbal and nonverbal measures, and is applicable to a wide age range (6 to 89 years). The WASI is not recommended for the purposes of medico-legal evaluations (Lezak et al., 2004); it was designed as a screening instrument, and is useful in research or in clinical situations where estimates of general cognitive ability are required, or where time constraints are a consideration (Psychological Corporation, 1999; Strauss et al., 2006).

2.4.2.12.2. Administration procedures for the WASI

The form and content of the WASI is similar to other Wechsler forms, specifically the WAIS-III and the WISC-III, but has different stimuli and employs *T*-scores instead of scaled scores (Lezak et al., 2004). It consists of 4 subtests (2 verbal and 2 performance subtests). The verbal subtests are Vocabulary and Similarities; the performance subtests are Block Design and Matrix Reasoning. The performance and verbal subtests are reported to measure fluid ability, and acquired (or crystallized) intelligence, respectively (Horn & Cattell, 1966; A. S. Kaufman, 1994).

The WASI version used here should be considered as experimental, because we adapted the verbal subtests in an attempt to improve the contextual appropriateness for our population. In order to evaluate the item suitability, all verbal items were administered to all participants, so the conventional start and stop points, and reverse and discontinuation rules, were not applied. Scoring rules were, however, applied exactly as specified in the test manual (Psychological Corporation, 1999), and points achieved beyond the age and achievement cut-off points were documented, but not included in the subtest totals. Performance subtests were unadapted; they were therefore administered and scored according to the specifications in the manual, using the age-appropriate start and stop points, reverse and discontinuation rules, and scoring systems. For all subtest raw scores, *T*-scores, and IQ profile scores, higher scores indicated better functioning.

2.4.2.12.3. Scoring procedures for the WASI

The individual subtest raw scores are converted to age-adjusted *T*-scores ranging from 20 to 80 (M = 50, SD = 10), then transformed into three IQ profile scores (M = 100, SD = 15). The profile scores are Verbal IQ (VIQ), Performance IQ (PIQ), and Full Scale IQ (FSIQ). The FSIQ is derived when all four subtests are used. A shortened version, consisting of Vocabulary and Matrix Reasoning, can be used to derive a Short-Form IQ (SFIQ) score (Psychological Corporation, 1999; Strauss et al., 2006).

2.4.2.12.4. WASI Subtests

Block Design: The Block Design subtest “reflects the individual’s ability to visually perceive and analyze abstract figures and to construct the whole from the component parts” (Psychological Corporation, 1999, p. 154), thereby enabling the measurement of visuo-spatial organization (within a time limit and incorporating a motor component); nonverbal reasoning; and general fluid intelligence. The task involves replicating a set of two-dimensional geometric designs using red- and white-coloured cubes, within specified time limits. Test materials consist of a set of 9 identical blocks (each with two red sides, two white sides, and two sides that are half red and half white), design cards, scoring rubric and a stopwatch. Scores for individual designs range from 0 to 2 (designs 1 to 4) or from 0 to 7 (designs 5 to 13); taking into account design accuracy and completion speed, with faster performance earning higher points. The scores for individual designs are tallied to form the Block Design raw score (range = 0 to 71).

Matrix Reasoning: The Matrix Reasoning subtest is conceptually similar to other progressive matrix reasoning tests (e.g., Raven’s Progressive and Colored Matrices (J. C. Raven, 1946, 1947) and other Wechsler Matrix Reasoning subtests (e.g., Wechsler, 1997). These tests measure the ability to perceive, manipulate, and abstract the relationships between symbols, thus measuring perceptual organization (without a time limit or motor component), visual analogical reasoning, and general fluid intelligence (Braze, Tabor, Shankweiler, & Mencl, 2007). The WASI Matrix Reasoning subtest consists of a series of incomplete geometric patterns in grids, each with a missing segment, which participants are required to identify from a selection of five alternatives. I applied the administration and scoring procedures exactly as described in the test manual (Psychological Corporation, 1999). Individual Matrix Reasoning problems were awarded 0 points if incorrect, and 1 point if correct, then tallied to form a total raw score (range = 0 to 35).

Similarities: The Similarities subtest measures the ability to observe relationships between concepts and to generalize the relationships into a unitary concept. The subtest therefore measures abstract verbal reasoning ability, as well as crystallized and general intelligence (Psychological Corporation, 1999). Test material consists of stimulus items and a scoring rubric with samples of responses which would warrant 0, 1, or 2 points. For the first four items, participants are shown a set of three pictures of objects that belong to a collective category (e.g., fruit) and another set of pictures, from which they are required to identify the one that is similar to the first set (e.g., a banana, rather than a bean, pumpkin or potato). For the remaining items, participants are required to explain what the concepts have in common (e.g., *cow* and *bear* are both animals). The level of abstraction of the concepts increases as the task progresses (e.g., for item 24, participants need to indicate that *Capitalism* and *Socialism* are both political/economic ideologies), and higher scores are awarded to responses that are less concrete and more abstract (Lezak et al., 2004).

Because the reverse and discontinuation rules and stop points in the manual corresponded with the age group of our sample, these administration procedures were unadapted except for the start point, which began at item 1 instead of item 5. Maximum scores were 1 and 2 for the first four items (picture recognition) and the remaining 22 items, respectively. Scores were tallied to calculate a raw score total (range = 0 to 48).

Vocabulary: The Vocabulary subtest is similar to vocabulary subtests in other Wechsler scales, but also includes four picture items, in which participants are required to name the items. Vocabulary items are presented visually and orally by the examiner, for the participant to define the meanings. This subtest, which measures the ability to verbalize the meaning of words, is also regarded as a useful measure of expressive language and general crystallized intelligence (Braze et al., 2007). Because vocabulary tends to remain intact after bilateral or diffuse head injury, this subtest has also proven to be a useful approximation of pre-morbid cognitive functioning (Lezak et al., 2004).

Test material consisted of the bilingual adapted word stimulus cards and adapted scoring rubrics, which provide samples of answers warranting either 0, 1 or 2 points, according to the accuracy and appropriateness of the responses (Lezak et al., 2004). Items increase in difficulty level (e.g., item 5 is *shirt* and item 40 is *formidable*). Answers which are more abstract and less concrete are awarded higher scores. Maximum scores of 1 for pictured items and 2 for printed and orally presented items were tallied to calculate a raw score total ranging from 0 to 72 (12- to 16-year-old range). Scores over age limit (last 4 items) or after discontinuation points (i.e., the point at which the manual specifies that the test administration should be discontinued because the prescribed number of items were failed consecutively) were documented by the examiners. Because of the high incidence of code mixing and code switching within our Afrikaans sample, vocabulary items were presented in both English and Afrikaans for all participants.

2.4.2.12.5. The utility of the WASI

The clinical utility of the WASI has not yet been widely investigated in the adolescent population. Clinical studies have demonstrated poorer performance on Block Design in American adolescents with early-onset alcohol initiation (Squeglia, Jacobus, & Tapert, 2009), and on Matrix Reasoning and FSIQ in cannabis-using adolescents in New Zealand (Harvey, Sellman, Porter, & Frampton, 2007). WASI FSIQ has proved to be useful in identifying intellectual disabilities in children and adolescents with Down syndrome and Williams syndrome (Edgin, Pennington, & Mervis, 2010).

The standardization study (Psychological Corporation, 1999) demonstrated poorer performance on all WASI indices in children and adolescents with mild and moderate mental retardation; reading disability; reading and math disability combined; and TBI. At the other end of the spectrum, the WASI has also proved its utility in identifying cognitive giftedness (Psychological Corporation, 1999).

2.4.2.12.6. Sociodemographic variables that influence WASI performance

Age and level of education: Because age affects WASI performance, norms are stratified by age (Psychological Corporation, 1999). Although the test developers report education levels, scores are not demographically corrected for education, which has been shown to have a mild effect on WASI performance (Hays, Reas, & Shaw, 2002; Strauss et al., 2006).

Sex: Young adult men have been reported to outperform women on the Block Design subtest (Snow & Weinstock, 1990), but sex effects were not reported in the WASI standardization study (Lezak et al., 2004).

Race, language, and quality of education: Cross-cultural effects on some, but not all of the WASI subtests and indices have been observed. Portuguese children and adolescents, of lower SES than the US standardization sample, attained 5 *T*-scores lower on Block Design, and 9 IQ points lower on PIQ (Psychological Corporation, 1999). Razani et al. (2007) found that ethnically diverse adults (i.e., from Hispanic, Asian and Middle-Eastern descent, living in the United States) performed worse than monolingual English-speaking Anglo-Americans on the WASI verbal subtests, but not on the performance subtests.

Racial differences have also been noted in WASI Block Design performance, with higher scores exhibited by white participants compared to other racial groups (e.g., A. S. Kaufman, McLean, & Reynolds, 1991; Marcopulos, McLain, & Giuliano, 1997). However, the observed differences are attenuated by factors such as higher acculturation to Westernized-urbanized contexts, and better quality of education (Ardila & Moreno, 2001; Manly et al., 1998).

In South Africa, cross-cultural effects have not yet been investigated on the WASI, but have been demonstrated in adolescents on other Wechsler intelligence scales. For example, black-polyglot disadvantaged senior school learners achieved IQ scores more than one SD lower than the US standardization sample on the WISC-R (Skuy et al., 2001). For the WISC-IV, Shuttleworth-Edwards et al. (in press) presented a continuum of results (see Section 1.7.8) demonstrating that when race and language were held constant, disadvantaged quality of education accounted for significant lowering of IQ scores in black-Xhosa, and coloured-Afrikaans adolescents.

2.4.2.13. Wechsler Intelligence Scale for Children, 4th UK Edition (WISC-IV): Coding Subtest

2.4.2.13.1. Description of the WISC-IV Coding subtest

Coding is a subtest used in various formats in most of the Wechsler intelligence scales. The task involves using a key to copy simple geometric shapes that are paired with numbers, within a specified time limit. The Coding B subtest from the WISC-IV measures information processing speed (Wechsler, 2004).

2.4.2.13.2. Administration procedures for the WISC-IV Coding Subtest

I used the test materials that are used in the standard administration, and consisted of a pencil, stopwatch, scoring key, and response sheet, which contained the coding key of 9 numbers with their matched symbols, sample items, and test items (i.e. empty boxes underneath numbers, in which participants were required to draw the corresponding symbols).

The administration procedures in the test manual (Wechsler, 2004, p. 99) were followed exactly. In sum, the examiner explained the task and demonstrated the first 3 items. Participants then completed the remaining four demonstration items, receiving direction from the examiner if necessary, then completed as many of the 119 items as possible. Timing began immediately after the examiner instructed the participant to begin, and ended after 120 seconds. Participants were not allowed to use an eraser, but were allowed to make spontaneous corrections by over-writing responses.

2.4.2.13.3. Scoring procedures for the WISC-IV Coding Subtest

The scorer used a scoring key to check the participant's responses. Responses that were imperfect, yet recognizable and clearly distinguishable from other symbols, were credited. One point was awarded for every correctly drawn or spontaneously corrected symbol drawn within the time limit. The total raw score was the number of credited symbols (excluding the sample items), ranging from 0 to 119, with higher scores representing better functioning.

2.4.2.13.4. The utility of the WISC-IV Coding Subtest

As the utility of the WISC-IV is described predominantly using the composite indices (e.g., FSIQ, Processing Speed Index), it is difficult to isolate the contexts in which the particular subtest has been found to be clinically useful. Nonetheless, the Coding subtest has been shown to be sensitive in psycho-educational contexts, where children with learning disabilities perform poorly (Evans & Stroebel, 1986; Watkins, Wilson, Kotz, Carbone, & Babula, 2006). In comparison with other Wechsler subtests, Coding has been consistently shown to be more sensitive to brain damage, even in mild cases, and regardless of lesion location (Lezak et al., 2004).

2.4.2.13.5. Sociodemographic variables that influence WISC-IV Coding Subtest performance

Age: Coding performance tends to improve gradually throughout childhood and adolescence (Wechsler, 2004).

Sex: In a sample of predominantly white, English-speaking, 8-year-old children with advantaged quality of education, Cockroft and Blackburn (2008) showed that girls outperformed boys on the Coding subtest of the Senior South African Individual Scale Revised version (SSAIS-R), which is similar to the WISC-IV Coding subtest.

Race, language, and quality of education: Scaled scores for WISC-IV Coding (using the UK conversion tables) in 12- to 13-year-old adolescents from the Eastern Cape province were differentially impacted by race, language, and quality of education, on a continuum (from lowest to highest scores) ranging from 5 to 8 scaled scores as follows: black-Xhosa-disadvantaged; coloured-Afrikaans-disadvantaged, and coloured-Afrikaans-advantaged; black-Xhosa-advantaged; white-English-advantaged; and white-Afrikaans-advantaged (Shuttleworth-Edwards et al., in press).

2.5. Cultural and linguistic adaptation of test materials

Although only Afrikaans- and English-speakers were included in the primary study, the principles and methodology were designed with Xhosa-speakers in mind as well, so as to facilitate extended studies (e.g., the parallel study) relevant to the Western Cape population. Two of the tests in the current battery (Verbal Fluency and the WASI) have thus been adapted and piloted in all three primary languages of the Western Cape Province. Experts in Afrikaans and Xhosa language and culture, viz., Dr. Simone Conradie (Stellenbosch University, Department of Linguistics) and Prof. Tessa Dowling (University of Cape Town, Department of African Languages) were used as consultants during the adaptation process. The primary goal of this process was to ensure equivalent difficulty of test items across the three languages, while at the same time retaining the difficulty level (and scale of items from easy to difficult) of the original instruments, and keeping the adaptations as close as possible to the original tests.

The challenges of using cognitive tests in cultural contexts other than those for whom the instruments were initially designed and standardized is not unique to South Africa. These challenges involve more than merely translating instruments into other languages. Some of the factors needing consideration have been highlighted in the body of international work, and include: the differences between formal and informal or colloquial language use; differences between written and oral language; the dynamic nature of language, which means that oral lexicons and formal representations of words and their emergent meanings are not synchronized (i.e., oral traditions tend to precede their dictionary representations); bi-, tri- and multi-lingualism; code switching (i.e., using whole sentences or phrases from another language) and code borrowing (i.e., using words from another language to complete sentences; Ardila et al., 2000; Echemendia & Harris, 2004; Manly, Byrd, Touradji, & Stern, 2004; Ostrosky-Solis et al., 1985; Ostrosky-Solis, Gomez-Perez et al., 2007; Wong & Fujii, 2004)

Based on the experiences of others attempting to ensure that assessment practices are as culture-fair as possible, we attempted to ensure item equivalence in the following aspects:

- word length, complexity (i.e., number of embeddings) and syllable count (e.g., *enthusiastic/entoesiasties; famous/beroemd; shirt/hemp*);
- word class;

- word meaning;
- word and sentence length, complexity, and difficulty levels;
- frequency of word use in the language; this factor overrides word and syllable length (e.g., *century/eeu/inkulungwane* differ in syllable count, but have the same meaning, word class, and frequency of use in all three languages);
- prevention of semantic ambiguity (e.g., *haastigheid* was used instead of *haas* as a translation for *haste*, because *haas* means *haste* as well as *hare*);
- acceptance of Anglicisms of Afrikaans words (though less acceptable from a purist point of view in terms of prescriptive grammar rules) as appropriate in this context because of their similarity to the English words, in syllable length, difficulty level, and frequency of colloquial use (e.g., *kalender* was preferred to *almanak* for the translation of *calendar*).

The language and culture experts were briefed thoroughly about the purpose of the tests, the demographic profile of the intended participants, the test material, and issues of concern. All test materials (including stimuli, instructions, and scoring rubrics) were scrutinized by the multidisciplinary team, according to the abovementioned considerations. Some tests were suitable for use in their original format, whereas others required adaptations, which are described in detail (see Section 2.5.2). Once tests had been approved by the team, all test material was translated into Afrikaans (and Xhosa, for the WASI and verbal fluency tests only) and back-translated into English by independent translators, then re-evaluated for accuracy and equivalence. The linguistically checked versions were then re-evaluated by me and my supervisors to ensure that any changes made by the language and cultural experts did not alter the nature or difficulty level of the tasks or tests. All test instructions (adapted and unadapted) are provided in English and Afrikaans (see Appendix 5.2.4).

Test language was established prior to testing by asking participants which languages they used at home and at school, which language they considered themselves to be most proficient in, and which language they would prefer to be tested in. All verbal test material (for example, WASI Vocabulary items) was available to all participants in both Afrikaans and English.

2.5.1. Unadapted tests

The following test instructions and stimulus materials were translated, but not adapted: CCTT; CMS Numbers; CLOX test; GPT 2; SCWT; ToL; Semantic Fluency test; WASI Block Design and Matrix Reasoning subtests; and the WISC-IV Coding subtest.

2.5.2. Adapted tests

The following tests were adapted: CMS Stories subtest; GPT 1; MAVLT; Phonemic Fluency test; and the WASI Vocabulary and Similarities subtests.

2.5.2.1. CMS Stories

I considered the relative advantages and disadvantages of using the original CMS Stories, adapting them to be more culturally relevant, or replacing them with local stories. The quest for cultural relativity seemed difficult because our team thought it unlikely that we would find a story that would be considered "relevant" for all sectors of our diverse local population. Using the original stories would, on the other hand, allow comparisons with international norms. Taking these factors into account, and in keeping with the task intentions (i.e., to test memory performance under overload conditions), we decided to retain the original stories from the CMS. Two words in story E (*pounds* and *miles*) were substituted with the local units of measurement (*kilograms* and *kilometers*).

2.5.2.2. Grooved Pegboard Test (GPT 1)

We made two minor adaptations to the instructions: 1) an explanatory sentence was added to explain the word *groove* by demonstrating that each peg had a round side and a square side; and 2) the word *go* was replaced with *begin* to indicate when the participant should commence the task, to keep the English and Afrikaans versions as similar as possible.

2.5.2.3. Maj's Auditory Verbal Learning Test (MAVLT)

Word list A was entirely suitable for local use. Some items were equivalent according to all the specified criteria, e.g., *arm/arm* and *hammer/hamer*. Some words differed in syllable length, but the translations were equivalent in meaning, conceptual difficulty, and frequency of use, e.g., *plane/vliegtuig* and *clock/horlosie*. In List B (the distractor list), three items were problematic: Item B1 *boot/stewel* - the Afrikaans word is used rarely (and only in more formal language use), so the semantically compatible words *shoe/skoen* were substituted; item B3 (*plate*) – the Afrikaans word *bakkie* is ambiguous, in that it could take the meaning of either *bowl* or *truck*, so the semantically compatible words *plate/bord* were substituted; item B9 (*bee*) – the Afrikaans word by is orally ambiguous, in that it could take the meaning of the preposition *at*, or the phoneme *bui* (meaning *mood)*; hence, and to ensure that the word was understood in its original semantic category (i.e., insects), the Afrikaans word *gogga* was used, as a generic description of a *bug*.

2.5.2.4. Verbal Fluency – Phonemic Fluency

Cross-lingual studies of Phonemic Fluency have been criticized on methodological grounds for a variety of reasons, for example, assuming letter equivalence without validating the assumption with empirical evidence, not articulating which letters are used, not describing the rationale or methods used to select letters, and not using normative data derived from healthy participants (Mitrushina et al., 2005). Sometimes previously established protocols, including the use of letter/s, are followed. This strategy is appropriate where the demographic profile is similar to the original, but problematic when the culturo-linguistic profile of the study population differs from the original.

Linguistic complexities have been avoided in many bi- and multi-lingual studies by only testing Semantic Fluency (Bethlehem, de Picciotto, & Watt, 2003; Kempler et al., 1998). Consequently, despite the widely acknowledged utility of Phonemic Fluency testing, there is a paucity of adequately stratified normative data for children, and for adolescents with fewer than 9 years of education, in developing countries and multi-lingual contexts. There are no published studies describing the rationale and methods used to select letter sets suitable for cross-lingual testing in South Africa. There are also no published normative data on a letter set capable of testing three official South African languages.

Consequently, before we were able to test Phonemic Fluency in our context, it was necessary to conduct a separate study (our secondary study) to establish which letters would be most suitable for Afrikaans-, English-, and Xhosa-speaking participants. Based on the precedent set in adult studies in other cultural contexts, where letters were selected in a principled and empirical manner (e.g., Benton, 1969; Borkowski, Benton, & Spreen, 1967; Gollan et al., 2002; Senhorini, Amaro Junior, de Mello Ayres, de Simone, & Busatto, 2006), our investigation consisted of three steps.

Step one: hierarchical ranking and selection of compatible letters: Many Xhosa dictionaries list words according to the root of the word. For example, the word “ladder” is listed under L as (*i,ii*)*leri*. The South African Multi-Language Dictionary and Phrase Book (Reader's Digest, 1991), which includes 5000 commonly used words translated into seven South African languages, however, lists the words as they are said, e.g., *ileri,* listed under I. In the context of Phonemic Fluency, such a listing is useful because there is no necessity to differentiate between the prefix and the root of the word, which would add an extra layer of complexity to the executive task for Xhosa-speakers. All words in each letter of the alphabet in the three languages were counted to establish the percentage of words beginning with each of the letters of the alphabet in all 3 languages. The letters were then ranked in order from the most to least frequent initial letter used.

Table 5 contains a list of letters considered to be unsuitable for cross-lingual comparisons, based on the abovementioned criteria. Table 6 shows which letters are, on the other hand, suitable for comparisons between English-, Afrikaans-, and Xhosa-speakers.
Letters were considered to be unsuitable for cross-linguist comparisons (see table 5) if their rank order differed by six positions between the three languages; or if the letters were considered to be potentially problematic with regards to spelling, pronunciation and orthography. Letters that we considered to be suitable, due to similarity in rank order, and absence of linguistic complexities described above, are listed in Table 6.

This linguistic analysis demonstrates that it would have been inadvisable to use the traditional COWAT letter sets (PRW and CFL) in our context. Letters PRW and C are all problematic due to the differences in rank order between Afrikaans, English, and Xhosa, respectively (P:11/4/9; R:13/8/24; W:15/15/26; C:23/2/8). A relatively common strategy to compensate for the Afrikaans disadvantage in using F (20/9) has been to "translate" F into its phonemic (similar sounding) Afrikaans equivalent, V. This strategy is ineffective because it merely transfers the bias between languages, disadvantaging English-speakers (9/2). Out of the six COWA(T) letters, only L (14/13/8) is suitable for cross-lingual comparisons between Afrikaans, English and Xhosa.

For the set of three letters to capture a range of difficulty, yet still be manageable for children (particularly those with disadvantaged quality of education), we decided to select: 1) the easiest letter in each language (which turned out to be S in Afrikaans and English and I in Xhosa); 2) an easy letter (ranked between 2 and 7), and 3) a moderately difficult letter (ranked between 8 and 15). The hierarchical ranking process gave us three possible easy options (B, A, and T) and two possible moderately difficult options (L and M). We selected B as the easiest and most closely ranked "easy" letter (B:3/5/5; A:3/7/7; T:8/7/6). It was not possible to differentiate between the moderately difficult letters merely on ranking (L:8/13/14 and M:10/10/14). Both letters have been widely used internationally (Strauss et al., 2006), and letter M has been used in Dutch (Van der Elst et al., 2006), making it potentially useful for English-Afrikaans comparisons. We thus decided to test both letters empirically to establish the better option.

Table 5. *Dictionary Ranking for Unsuitable Letters with Ranking Differences Greater than 6 and Letter Ranking Difficulty Greater than 15, for Afrikaans, English and Xhosa*

Letter	Afrikaans		English		Xhosa	
	Word *n*	**Letter Rank**	**Word *n***	**Letter Rank**	**Word *n***	**Letter Rank**
C	6	23	461	2	97	8
D	200	12	285	6	53	18
E	106	16	211	11	49	19
F	60	20	241	9	58	17
G	262	6	144	16	73	13
H	219	9	186	12	60	16
J	37	21	45	20	18	25
K	357	5	40	21	174	4
N	99	17	91	19	431	3
O	364	4	117	17	68	15
P	211	11	388	4	93	9
Q	0	25	23	23	86	10
R	192	13	251	8	23	24
U	73	19	103	18	1131	2
V	552	2	40	21	49	19
W	155	15	163	15	4	26
X	2	24	2	26	45	21
Y	8	22	21	24	27	23
Z	0	25	6	25	79	12

Table 6. *Dictionary Ranking for Suitable Letters Ranked Similarly in Afrikaans, English and Xhosa*

Letter	Afrikaans		English		Xhosa	
	Word *n*	**Letter Rank**	**Word *n***	**Letter Rank**	**Word *n***	**Letter Rank**
A	241	7	395	3	110	7
B	469	3	322	5	167	5
I*	87	18	180	14	1734	1
L	162	14	183	13	98	8
M	215	10	233	10	71	14
S**	579	1	633	1	80	6
T	224	8	260	7	138	2

*Note.** Letter ‘I’ is highest ranked letter for Xhosa; ** Highest English and Afrikaans rank but unsuitable for Xhosa.

Step two: empirical testing to establish the most suitable letter set and the relative influences of demographic variables on Phonemic Fluency: To evaluate the suitability of the selected letters, we compared Phonemic Fluency performance on a sample of 512 participants (258 females and 254 males) between the ages of 7 and 25, with 1-17 years of completed education, and evaluated the relative impact of age, level and quality of education, and language. Performance on all 4 letters differed within language groups according to quality of education, with advantaged groups achieving significantly higher scores (range: $p < .01$ to $p = .02$) than disadvantaged groups in all languages. Performance on letter S(I) only differed between English and Afrikaans advantaged groups ($U = 2957.5$, $p < .01$). Letter B showed differences between English and Afrikaans disadvantaged ($U = 2167.5$, $p < .01$); English and Xhosa disadvantaged ($U = 2002.5$, $p < .001$); and between English and Xhosa advantaged ($U = 3097.5$, $p = .01$). For letter L, disadvantaged English speakers generated more words than Afrikaans ($F = 9.48$, $p < .001$) and Xhosa ($U = 2008$, $p < .001$) participants. All differences cited above demonstrated superior performances by English-speakers compared to Afrikaans- and Xhosa-speakers. Letter M was problematic in that significant between-group differences were found in 4 out of 6 comparisons. Letter L was thus selected as preferable to M, making the final letter set LBS(I).

Step three: tabulation of normative data for the most suitable letter set, stratified according to significantly influential variables: We stratified the norms for the LBS(I) letter set in five education bands, by language (English, and Afrikaans combined with Xhosa), and by quality of education. Table 7 shows the normative data.

Table 7. Norms: Performance on letters S, B, and L for English- and Afrikaans-speakers, letters I, B, and L for Xhosa speakers, stratified by language, level and quality of education

Education Band	**Letter / Set**	**English (*n*=174)**		**Afrikaans and Xhosa (*n*=338)**	
		Disadvantaged	**Advantaged**	**Disadvantaged**	**Advantaged**
		M (SD)	**M (SD)**	**M (SD)**	**M (SD)**
Junior Primary ($n = 89$)	S/I	7.95 (4.40)	9.63 (2.50)	8.10 (3.52)	9.64 (3.20)
	B	9.05 (3.34)	9.75 (2.12)	6.49 (2.34)	7.64 (1.69)
	L	7.26 (2.99)	7.75 (2.92)	5.04 (2.80)	7.73 (2.83)
	Set	24.26 (9.01)	27.13 (6.56)	19.63 (6.71)	25.00 (4.34)
Senior Primary ($n = 109$)	S/I	9.70 (3.39)	11.05 (3.33)	9.87 (3.58)	10.38 (3.20)
	B	9.96 (2.80)	10.80 (2.84)	8.56 (2.42)	9.05 (2.59)
	L	8.57 (2.06)	8.45 (3.94)	7.73 (3.09)	8.00 (3.78)
	S(I)BL	28.22 (7.54)	30.30 (8.76)	26.16 (7.44)	27.43 (7.78)
Junior Secondary ($n = 83$)	S/I	11.73 (2.24)	11.00 (5.59)	10.93 (3.97)	11.93 (4.26)
	B	11.91 (3.36)	12.08 (4.14)	10.33 (3.63)	11.60 (3.05)
	L	11.45 (3.24)	9.17 (4.04)	8.50 (3.11)	10.37 (2.66)
	Set	35.09 (7.99)	32.25 (12.61)	29.77 (9.27)	33.90 (8.13)
Senior Secondary ($n = 68$)	S/I	13.47 (4.09)	13.86 (2.67)	10.54 (4.27)	12.36 (3.16)
	B	14.27 (3.63)	12.14 (3.13)	10.26 (4.56)	12.21 (3.05)
	L	12.67 (3.31)	11.86 (1.35)	8.85 (3.24)	10.97 (2.35)
	Set	40.40 (9.86)	37.86 (4.81)	30.00 (11.14)	35.55 (6.98)
Tertiary ($n = 163$)	S/I	13.83 (3.06)	17.02 (4.18)	12.67 (3.73)	14.32 (3.70)
	B	15.17 (3.49)	16.19 (3.99)	13.81 (4.61)	14.39 (4.02)
	L	13.33 (3.39)	14.72 (4.29)	10.96 (3.23)	12.17 (3.39)
	Set	42.33 (8.98)	47.92 (10.77)	37.44 (8.35)	40.88 (9.94)

2.5.2.5. WASI Similarities Subtest

The English and Afrikaans versions of all 26 word pairs were sufficiently equivalent (according to the criteria specified above) not to warrant any replacement items. Potential ambiguities in meanings of two of the Afrikaans words necessitated reverse-ordering of two word pairs: Items 12 and 21 were presented in reverse order from the original version because the word *bakkie* also means *truck*, and *meer* also means *lake*. The items were thus presented as *plate-bowl/bord-bakkie* and *less-more/minder-meer*.

2.5.2.6. WASI Vocabulary Subtest

The scoring rubrics were extended for the following three items, to incorporate multiple and alternative colloquial (but accurate) meanings:

- Item 2: *spade* was added as an acceptable synonym for *shovel*, which is not frequently used in South Africa.
- Item 24: *vermaak* has a colloquial meaning unique within the Cape coloured population, meaning *to reject or withhold*. This meaning only emerged during the testing process, when a tester from the same background as the participants highlighted the problem. The language and cultural experts had not encountered the alternative meaning previously, but found it as a footnote in one of six dictionaries consulted. At that point, the rubric was amended to include the alternative meaning, and all previously marked tests were re-scored to ensure compatibility with the revised rubric.
- Item 35: *onderbroke* also means *interrupted* in Afrikaans, so this meaning was included in the scoring rubric.

Nine out of the 42 original words were replaced for the following reasons:

- Two culturally unfamiliar or unknown items were replaced with more familiar local words of equivalent meaning and difficulty level, viz., item 7: *flashlight* and item 19: *alligator* were replaced with *torch/flits/itotshi* and *crocodile/krokodil/icrocodile*, respectively.
- Three words that contained explanatory cues in their construction in one language but not in the other languages were substituted with words with similar meanings, but without the explanatory cues. The original words, when broken down into semantic units, contained all the information necessary to provide 2-point scores without further explanation. Examples included item 13 in Xhosa: (*ishumi = ten; -nyaka = years*) and item 27 in Afrikaans: (*middag = midday; ete = meal*), which provide explanatory cues for *decade* and *lunch*, which are not inherent in the English word construction. To

ensure equivalent difficulty between the languages, these words were replaced with semantically equivalent alternatives which did not contain inherent explanatory cues, viz., *breakfast/ontbyt/ibrekfasti* and *century/eeu/inkulungwane*. Item 16 in Afrikaans *troeteldier* (troetel = to pet or nurture; dier = animal) also contained explanatory cues, but lacked an appropriate semantically equivalent substitute, so was replaced with an item deemed to be of equivalent conceptual difficulty level (viz., *repair/herstel/ukulungisa*) from the WAIS-III (Wechsler, 1997). The latter instrument has been translated into Afrikaans for use in South Africa, i.e., the South African Wechsler Adult Intelligence Scale (SA-WAIS; Claassen et al., 2001) thus contains translated items and scoring rubrics in Afrikaans.

- Four original English items either had a multiple-word translation for the concept or no equivalent translation because the concept was culturally unfamiliar. These included item 31: *improvise*; item 36: *devout*; item 38: *niche*; and item 42: *panacea*, which were substituted with *complicated/gekompliseerd/-ntsonkothileyo*; *compassion/deernis/uvelwano*; *colony/kolonie/ikoloni*, and *tirade/tirade/ukungxolisa*. These words were replaced with items from the WAIS-III and SA-WAIS (as described above), which we considered to be of equivalent conceptual difficulty (i.e., at an equivalent level of abstraction) to the original items. Replacement items were ordered relative to the placement positions in the WAIS versions, e.g., *tirade* was substituted as the most difficult item (number 33 in the WAIS and number 42 in the WASI).

2.6. Data management and statistical analysis

2.6.1. Data management

I scored and coded all cognitive tests individually, having addressed scoring ambiguities and queries with Dr. Thomas and Prof. Tapert. Data were entered, checked, and cross-checked by appropriately trained research assistants. Planning of statistical models and methods was done in consultation with a statistician (Prof. Martin Kidd). I conducted all statistical procedures, under the guidance of my supervisory team, using the *Statistical Package for the Social Sciences* (*SPSS)* version 17 (SPSS, 2008), except for principal component analyses (PCA's), which were performed by the statistician, using *Statistica* version 9 (StatSoft, 2009).

2.6.2. Data analysis

2.6.2.1. Preliminary analyses

Assumptions: Data were checked for outliers and graphic indications of problems with distributions. Assumptions for parametric data were then checked. Kolmogorov-Smirnov and Levene's statistics were calculated to check for normality of distributions and for homogeneity of variance, respectively. The selection of statistical analytical techniques was determined by the type and distribution of the data. Chi-square tests were used to compare categorical data, and Spearman's correlations were used to compare ordinal data. For some of the cognitive outcome variables, data did not uphold the assumptions for parametric data. For such nonparametric data (e.g., Error scores and Interference indices), only descriptive statistics were calculated.

Descriptive statistics: Means, standard deviations, frequencies, and percentiles were calculated for all independent variables (viz., age, level of education, sex, race, language, quality of education, and socioeconomic status) and all dependent variables (i.e., all cognitive test scores).

2.6.2.2. Evaluation of sociodemographic effects on cognitive performance

In order to determine how to stratify the norms, it was necessary to ascertain the relative impact of the sociodemographic variables on all of the cognitive measures that upheld the assumptions for parametric data. Analyses of covariance (ANCOVAs) and post-hoc analyses were performed to demonstrate the main and interaction effects of the independent variables on each cognitive measure. Principal component analysis (PCA) biplots were created to graphically represent the relationships between cognitive domain scores and sociodemographic variables.

2.6.2.2.1. Analyses of covariance (ANCOVAs)

For each of the first set of ANCOVAs (for the whole sample), the cognitive measure was entered as the dependent variable; age (as a continuous variable) was entered as a covariate; and sex, language, and quality of education (which were all dichotomous), were entered as independent variables of factors. Because the group with disadvantaged quality of education consisted only of coloured participants, no further analyses were necessary.

The group with advantaged quality of education, on the other hand, contained coloured and white participants, necessitating further investigation of possible interaction effects between race and the other sociodemographic variables. I first performed a series of analyses of variance (ANOVAs) with race as the independent variable, and all parametric cognitive test scores as dependent variables, to ascertain whether there were differences in performance between coloured and white participants within the group with advantaged quality of education. For the cognitive measures where significant differences between the racial groups were shown, further ANCOVAs were performed to investigate the relative contributions between the independent variables. For this second set of ANCOVAs, the cognitive measure was entered as the dependent variable; age as the covariate; and sex, language, and race as fixed factors.

2.6.2.2.2. Post-hoc analyses of age differences

For measures that demonstrated significant main age effects on cognitive performance, further investigations were necessary to indicate how to subdivide the age groups in the norm tables. The following procedures were followed:

- Age was treated as a categorical variable with 4 discrete groups: 1) 12-year-olds (12.0 to 12.11 years); 2) 13-year-olds (13.0 to 13.11 years); 3) 14-year-olds (14.0 to 14.11 years); and 4) 15-year-olds (15.0 to 15.11 years)
- Means plots were created to demonstrate age-related trajectories graphically
- Post-hoc analyses (ANOVAs with LSD tests) were performed to locate mean differences in performance on selective neuropsychological variables between the age groups (i.e., 12 and 13; 12 and 14; 12 and 15; 13 and 14; 13 and 15; 14 and 15 years).

2.6.2.2.3. Principal component analysis biplots

Composite cognitive domain scores: The multiple cognitive measures were reduced into composite domain scores. In order to do this, I first reverse-scored the timed measures, so that they would be consistent with other cognitive measures in that higher scores represented optimal functioning. All scores were then transformed to the same unit of measurement (i.e., *z*-scores). I clustered the cognitive measures together based on theoretical grounds, that is, cognitive output variables that were purported to measure the same domain were clustered together, according to the test developers' descriptions, and the descriptions in the three core neuropsychological texts (Lezak et al., 2004; Mitrushina et al., 2005; Strauss et al., 2006). Cronbach's alpha coefficients were calculated to quantify the extent to which the variables in each domain were correlated. Individual measures that reduced the alpha values to less than .50, were excluded from the composite domains.

Principal component analysis biplots: Principal component analysis is a data reduction technique based on the principle of factor analysis, but yielding outputs of multivariate relationships in graphic format. Because of the reductionist nature of PCA, some information is lost. As part of the analysis, *R*-squared statistics are calculated and plotted on a line plot for each domain score. The *R*-squared value indicates how well each domain fits the analytic model (i.e. the relative proportion of variance in each domain score that would be represented on the principal analysis plots). Domain scores that did not fit the model well were excluded from the PCA biplots.

The cognitive domains that did fit the model were represented on the PCA biplots in relation to the sociodemographic variables. In the context of this study, the visual representation demonstrates the pattern of variance in cognitive performance and the extent to which sociodemographic variables are associated with cognitive domain scores. The relationships between cognitive domain scores and 5 different independent variables (viz., sex; language; quality of education; age category for the whole sample; and race, for the advantaged subsample only) were graphically represented on the PCA biplots.

2.6.2.3. Norm tables

Stratification of normative data: Using the information yielded by the ANCOVAs and post-hoc analyses, descriptive statistics were calculated for each subgroup for each cognitive measure. For example, if a particular measure was significantly affected by age and quality of education, but not by sex, language, or race, and if 12-year-olds performed worse than 13- to 15-year-olds, descriptive statistics were calculated separately for four subgroups, as follows: 1) 12-year-olds with advantaged quality of education; 2) 12-year-olds with disadvantaged quality of education; 3) 13- to 15-year-olds with advantaged quality of education; and 4) 13- to 15-year-olds with disadvantaged quality of education.

Creation of norm conversion tables: There were three subsequent steps necessary to create the normative conversion tables:

1) percentile ranks were calculated for each cognitive outcome measure, for each sociodemographically stratified subgroup;
2) a template table based on the relationships between different standardized scores in relation to the standard normal distribution was created. The standardized

scores that were tabulated in relation to the percentile ranks included Standard Scores, *T*-scores, Scaled Scores, *z*-scores, and percentile ranks;

3) The raw scores corresponding to the percentiles (and other standardized scores) were plotted on separate tables for each outcome variable, stratified according to the relevant sociodemographic variables.

2.6.2.4. Comparisons between norms from this study and non-local norms

2.6.2.4.1. *T*-tests

In order to evaluate the relative utility of the norms created from this study compared to previously published norms, group means were compared using single-sample *t*-tests. I performed single-sample t-tests comparing our data to means and standard deviations published in other studies. For tests that required raw scores to be converted into other types of scores, for example, *T*-scores or IQ scores, raw scores were transformed twice: firstly, using the conversion tables in the published manuals (derived from data from the test standardization samples); and secondly, using the norm tables from this study (see Appendix D).

2.6.2.4.2. WASI cross-cultural comparisons

I calculated the percentage of participants that fell within each of the interpretive performance ranges, using 1) norms from this study and 2) the WASI standardization norms.

2.6.2.4.3. *T*-score plots of individual performances using local and non-local norms

In order to illustrate the clinical interpretive issues associated with using inappropriate norms, I randomly selected two cases (one with exposure to advantaged quality of education, and one with exposure to disadvantaged quality of education). Using the study norm tables, and non-local norms, I transformed raw scores to *T*-scores for each case, on a cognitive measure representing each domain. The *T*-scores derived from the two different sets of norms were plotted graphically.

2.6.2.5. Control of Type I and Type II errors

When multiple analyses are performed, there is an increased probability that some of the comparisons will yield significant results purely by chance. This raises the possibility of Type I error (i.e., believing that there is a genuine effect in the population, when in fact there is not) (Field, 2005, p. 748). Type I errors are usually controlled by adjusting the significance levels to a more stringent level (e.g., .01 instead of .05) to compensate. However, controlling for Type I errors raises the chances of committing Type II errors (i.e., believing that there is no effect in the population, when in reality, there is).

The consultant statistician for this study suggested that adjustments to the significance level might obscure important sociodemographic effects. For this particular study, the primary purpose of the statistical analyses was to determine how to stratify the norms appropriately. It was thus considered more prudent not to adjust for Type I errors, but rather to interpret significant differences in relation to the overall findings and to previous findings in the literature. Consequently, it is possible that some of the differences in performance demonstrated between the subgroups may be due to chance.

3. Results and Discussion

The general aim of this study was to ascertain whether cognitive tests developed in settings outside of the Western Cape urbanized region have valid application for clinical and research purposes in the specified population. The first strategy used to meet the general aim was discussed extensively in the Methods section; it involved the cultural and linguistic adaptation, and subsequent administration, of the cognitive tests.

The second strategy used to meet the general study aim was evaluation of the relative impact of sociodemographic factors (specifically age, sex, language, quality of education, and race) on cognitive test performance, and the subsequent creation of appropriately stratified normative data.

The third strategy was to evaluate the utility of the adapted tests and norms via cross-cultural comparisons between the study norms and non-local norms. Such evaluation allowed me to illustrate some of the interpretive problems associated with using inappropriate norms.

The combined Results and Discussion that follows here focuses on the abovementioned second and third strategies. This section of the thesis is thus structured in the following way:

I address each cognitive test in alphabetical order; for each one I (a) describe the relative influences of sociodemographic factors on test performance within the study sample, (b) provide appropriately stratified descriptive normative data on the bases of those sociodemographic analyses, and (c) describe the cross-cultural utility of the test.

The second section contains an overview of the effects of the sociodemographic factors on the tests in general, and on the functional cognitive domains.

The third section includes two case studies illustrating some of the interpretive problems associated with using inappropriate norms.

3.1. Evaluation of the sociodemographic influences, stratification of norms, and cross-cultural normative comparisons for each cognitive test

3.1.1. The Children's Color Trails Test (CCTT)

3.1.1.1. CCTT: Relative influences of sociodemographic factors and stratified norms

Table 8. *CCTT Analyses of Covariance: Effects of age, sex, language, and quality of education on completion times (in seconds)*

	Trial 1			Trial 2		
	F	***p***	ω^2	***F***	***p***	ω^2
Main Effect						
Age	27.18	**< .001**	.117	14.96	**< .001**	.068
Sex	2.55	.112	.012	0.04	.842	.001
Language	0.78	.380	.004	1.75	.187	.008
Quality of Education	5.59	**.019**	.026	17.08	**< .001**	.077
Interaction Effect						
Sex x Language	2.72	.101	.013	0.24	.626	.001
Sex x Quality of Education	0.64	.423	.003	1.30	.256	.006
Language x Quality of Education	0.32	.573	.002	0.08	.783	.001
Sex x Language x Quality of Education	0.03	.858	.001	0.65	.421	.003

Table 8 presents a summary of the analyses of the relative influences of the sociodemographic factors on the cognitive functions of selective attention and cognitive flexibility (specifically, set-shifting), as measured by completion times on CCTT Trials 1 and 2, respectively. These analyses demonstrated that younger age and disadvantaged quality of education adversely affected performance. For Trial 1, age accounted for a greater percentage of variance (11.7%) than quality of education (2.6%), whereas for Trial 2, the relative contributions of age (6.8%) and quality of education (7.7%) were similar.

As Table 8 shows, there were no statistically significant differences in CCTT performance between females and males or between Afrikaans- and English-speakers, and no statistically significant interaction effects. Hence, previous suggestions of a male advantage on CCTT 1 (Llorente, Turcich, & Lawrence, 2004) and a female advantage on CCTT 2 (Williams et al., 1995) were not confirmed in the current study. The aforementioned findings are unusual, as most studies on trail-making tests have not demonstrated sex differences (Lezak et al., 2004; Strauss et al., 2006).

Our findings also contrast with previous evidence of language differences in CCTT performance times. Mok and colleagues (2008) demonstrated, in a sample of children from Hong Kong, that Mandarin speakers completed both trials faster than Mandarin-English bilinguals and English monolinguals. It is possible that lexigramatic differences between English and Mandarin written language may partially explain the differences demonstrated within the Hong Kong sample. Because the English and Afrikaans languages employ the same system of lexigrams, however, there may be an absence of between-language differences in CCTT performance in the current sample. However, I did not examine the effects of bilingualism or multilingualism on any of the measures in this study, and the effects of these particular aspects of language on tracking and shifting tasks may be an interesting topic for further investigation.

Because of the unequal racial distribution within the whole sample (i.e., two-thirds were coloured, and there were no white participants with disadvantaged quality of education), the effects of race were investigated within the advantaged group only. Analyses of variance explored whether there were significant between-race differences in performance within the group with advantaged quality of education. If the ANOVAs revealed significant differences, further ANCOVAs were conducted to evaluate the relative contribution of age, sex, language, and race on cognitive performance within this group.

Table 9 shows there were no statistically significant differences in CCTT scores between coloured and white participants within the group with advantaged quality of education. Hence, there was no need for separate ANCOVAs including race as a covariate.

Table 9. *CCTT Analyses of Variance: Between-race comparisons for participants with advantaged quality of education on completion times*

Outcome Measure	**Race**						**ANOVA Test Statistics**	
	Coloured			**White**				
	n	***M***	***SD***	***n***	***M***	***SD***	***F***	***p***
Trial 1	27	23.44	6.45	67	24.25	8.08	0.22	.644
Trial 2	27	41.78	10.33	67	38.94	10.67	1.39	.242

Note. Completion time data are presented in seconds.

Because age was shown to be associated with performance on both CCTT outcome measures (see Table 8), it was necessary to determine how to cluster age-groups for the normative data. The results of the consequent post-hoc LSD analyses (see Table 10) and means plots (see, e.g., Figure 2) demonstrated that there were statistically significant age-related differences in performance on both CCTT trials between 12-year-olds and each of the other three age-groups, whereas there were no statistically significant differences between the latter. As such, the stability of performance on the CCTT completion times between the ages of 12 and 16 demonstrated in other normative studies (Llorente et al., 2003; Williams et al., 1995) seemed to occur a year later in the current sample, with 12-year-olds needing more time to complete the tasks than 13- to 15-year olds, whose performance was consistent. The poorer performance by 12-year-olds may be indicative of developmentally-related limitations in those younger adolescents' capacity for cognitive control, an observation consistent with those made in other studies (P. Anderson, 2002; Luna, 2009).

Table 10. *CCTT Post-hoc LSD Analyses: Mean differences for age-group comparisons on completion times*

Age (years)	Trial 1		Trial 2	
	Mean Difference	***p***	**Mean Difference**	***p***
12 vs 13	4.19	**.013**	7.57	**.005**
12 vs 14	5.84	**<.001**	7.06	**.006**
12 vs 15	7.29	**<.001**	6.52	**.009**
13 vs 14	1.65	.351	-0.51	.856
13 vs 15	3.10	.072	-1.05	.700
14 vs 15	1.45	.382	-0.54	.838

Note. Completion time data are presented in seconds.

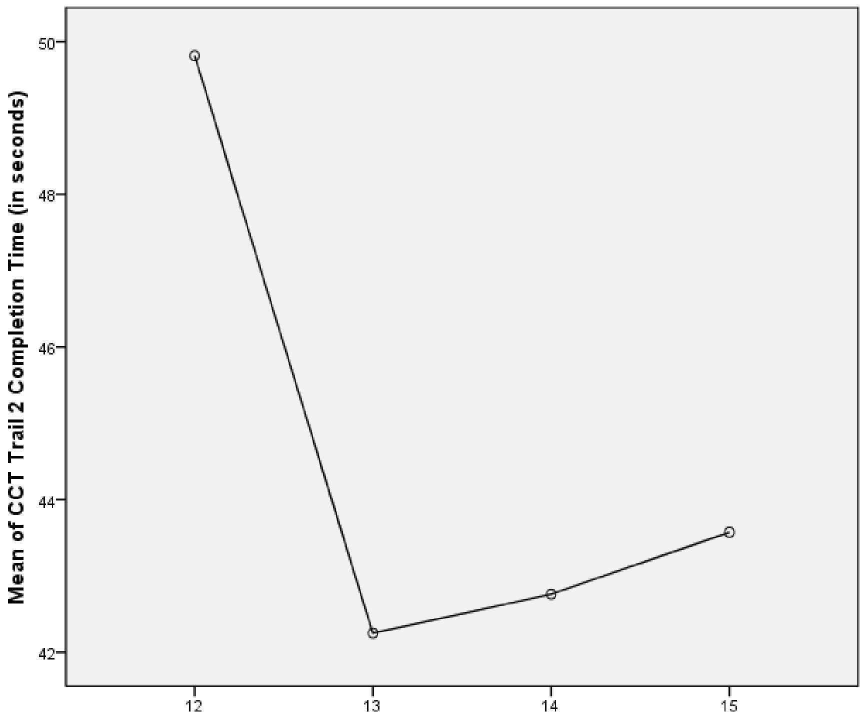

Figure 2. CCTT means plot by age-group for trial 2 completion time (in seconds).

Given the data reported in Tables 9 and 10, as summarized above, the descriptive normative data for this test (presented in Table 11) were stratified by two levels of quality of education (advantaged and disadvantaged) and by two age groups (12-year-olds, and 13- to 15-year-olds). I present normative conversion tables for the four stratified groups in Appendix D (Tables D-1 to D-8).

Table 11. *CCTT Descriptive Normative Data: Stratified by age and quality of education, for completion times*

Age (years)	**Quality of Education**	**Trial 1**				**Trial 2**			
		n	***M***	***SD***	**Range**	***n***	***M***	***SD***	**Range**
12	Advantaged	31	26.77	7.35	16 - 45	31	43.48	9.20	27 - 65
12	Disadvantaged	34	32.82	9.22	17 - 53	34	55.59	14.77	32 - 100
13 to 15	Advantaged	63	22.13	7.44	8 - 48	63	37.92	10.82	19 - 75
13 to 15	Disadvantaged	87	22.67	8.99	10 - 59	87	46.53	13.94	21 - 98

Note. Completion time data are presented in seconds; the sample ($N = 215$) included female and male, Afrikaans- and English-speaking participants; groups with advantaged quality of education included coloured and white participants; groups with disadvantaged quality of education included coloured participants.

The results for CCTT1 shown in Table 11 demonstrate an interesting trend that will be repeated in some of the tests discussed later in this section: age effects tend to be larger in groups with disadvantaged, rather than advantaged, quality of education. In relation to the SDs of the disadvantaged (6.79) and advantaged (7.62) groups, the mean difference (10.15) in scores between disadvantaged 12-year-olds and disadvantaged 13- to 15-year-olds was clinically significant (i.e., it exceeded 1 SD). In contrast, the mean difference (4.64) between advantaged 12-year-olds and advantaged 13-year-olds was statistically significant, but not clinically meaningful (i.e., less than 1 SD).

Table 12 presents normative indications for the CCTT error and interference scores for the whole sample. The distributions for these types of data were nonparametric, so norms were not stratified for these outcome measures. Interference scores greater than 3 are considered to be useful indicators of subtle cognitive slippage (Lezak et al., 2004). On average, the study sample committed less than one error and attained interference scores less than one. In future studies, it would be useful to assess the utility of the error and interference scores, and Trial 2 in particular, in clinical samples, because these outcome measures have been shown to be sensitive to emerging executive dysfunction in clinical conditions, for example, mild brain injury and ADHD (Lezak et al., 2004; Llorente et al., 2004).

Table 12. *CCTT Descriptive Normative Data: Error scores and interference index*

Interference Index		***M***			***SD***	**Range**
		0.87			0.69	-0.15 - 5.25
Error Types	**Trial 1**			**Trial 2**		
	M	***SD***	**Range**	***M***	***SD***	**Range**
Near Misses	0.06	0.24	0 - 1	0.13	0.38	0 - 2
Prompts	0.01	0.12	0 -1	0.11	0.32	0 -1
Number Sequence Errors	0.04	0.19	0 - 1	0.02	0.17	0 - 2
Color Sequence Errors				0.23	0.55	0 - 3

Note. The sample ($N = 215$) included coloured and white, 12- to 15-year-old, female and male, Afrikaans- and English-speaking participants with advantaged and disadvantaged quality of education.

In summary, the current data are generally consistent with other literature regarding trends of performance across the CCTT outcome measures. For example, errors were infrequent, and interference effects were minimal; and completion times for Trial 2 were slower than for Trial 1, probably due to the relative complexity of the former task (Lezak et al., 2004; Llorente et al., 2003; Williams et al., 1995).

3.1.1.2. CCTT: Cross-cultural comparison of norms

In order to investigate the cross-cultural utility of the Western Cape CCTT norms derived from the current data, I compared those data with the smoothed standardization norms published in Llorente et al.'s (Llorente et al., 2003) test manual. For this comparison, I used the age-group divisions that were used in the manual, and I stratified each age-group by quality of education. As shown in Table 13, single-sample *t*-tests demonstrated that, regardless of quality of education and across all age-groups, completion times for participants in the current study were significantly slower than those for the American standardization sample. Effect size estimates were large (> .70) for most of the subgroups, and moderate (.63 to .70) for three of the advantaged subgroups.

I used the SDs from the standardization sample to evaluate whether the mean differences between local and non-local norms were clinically significant (i.e., > 1 SD), over and above being statistically significant. Table 13 also shows the relevant data here. For CCTT1, within the group with advantaged education, slower completion times were clinically significant (> 1 SD) for the local 12-, 13- and 14-year-olds, but not for the 15-year-olds. For participants with disadvantaged quality of education, the mean differences between local and non-local norms were clinically significant for all age-groups, but substantially slower completion times (> 2 SDs) were exhibited by the 12- and 13-year olds.

For CCTT2, within the group with advantaged education, completion times for the local participants were not clinically significant (i.e., were < 1 SD) in comparison with the USA norms. For participants with disadvantaged quality of education, however, mean differences were greater than 1 SD for 12-, 13-, and 14-year-olds, and larger than 2 SDs for 15-year-olds.

In accordance with the results presented above, although the standardization norms are similar to the local norms for Trial 2, I recommend using local norms for Trial 1, even for participants with advantaged education. Furthermore, it is essential to use local norms for participants with disadvantaged education.

Table 13. *CCTT Cross-Cultural Utility: Comparisons between local and non-local norms for completion times*

Llorente et al (2003) USA Standardization Smoothed Norms			**Western Cape Norms***					**T-test Statistics**		
Age	***n***	***M* *(SD)***	**Q Ed**	***n***	***M***	***SD***	**Mean Diff**	***t***	***p***	***ESE***
Trial 1										
12	68	16.30 (6.39)	Adv	31	26.77	7.35	10.47	7.94	**<.001**	1.55
			Dis	34	32.82	9.22	16.52	10.45	**<.001**	2.20
13	54	15.37 (5.75)	Adv	26	25.23	5.49	9.86	9.15	**<.001**	1.72
			Dis	18	26.50	6.29	11.13	7.51	**<.001**	1.87
14	125	14.75 (5.12)	Adv	18	23.44	8.75	8.69	4.22	**<.001**	1.52
			Dis	32	24.47	6.59	9.72	8.34	**<.001**	1.78
15	84	14.44 (4.48)	Adv	19	18.42	6.89	3.98	2.52	**.021**	0.79
			Dis	37	25.03	11.66	10.59	5.52	**<.001**	1.42
Trial 2										
12	68	34.98 (13.02)	Adv	31	43.48	9.20	8.50	5.15	**<.001**	0.70
			Dis	34	55.59	14.77	20.61	8.14	**<.001**	1.50
13	54	32.33 (11.68)	Adv	26	39.55	7.98	7.02	4.48	**<.001**	0.65
			Dis	18	46.44	13.13	14.11	4.56	**<.001**	1.16
14	125	30.28 (10.34)	Adv	18	39.44	15.02	9.16	2.59	**.019**	0.83
			Dis	32	44.63	9.21	14.35	8.81	**<.001**	1.41
15	84	28.81 (9.00)	Adv	19	34.53	9.19	5.72	2.71	**.014**	0.63
			Dis	37	48.22	17.42	19.41	6.78	**<.001**	1.58

Note. Completion time data are presented in seconds; ESE = Hedges' *g* effect size estimate; *the sample (*N* = 215) included female and male, Afrikaans- and English-speaking participants; Q Ed = Quality of Education; Adv = subgroups with advantaged quality of education, which included coloured and white participants; Dis = subgroups with disadvantaged quality of education, which included coloured participants.

The overall pattern of slower performance by the South African sample is not uncommon for speeded cognitive tests administered to individuals in developing-world countries (Nell, 2000). The differences in speed may reflect ideological differences regarding the relative importance of accuracy versus speed (Grieve, 2005). The pronounced slow performances by participants with disadvantaged education may also reflect diminished opportunities to develop test-taking skills within under-resourced education systems (C. D. Foxcroft, 2004; Kanjee, 2005).

The mean scores for all except one subgroup (i.e., 15-year-old advantaged) in the study sample were lower than the mean performance (19.3) for adolescents with ADHD and mild head injuries in the abnorms published by Llorente et al. (2003, p. 25, Table 7). That fact serves to illustrate this point: The implications of these cross-cultural comparisons are that although the CCTT is “culture-fair” in the sense that the test is well-tolerated by, and user-friendly for, this particular South African sample, it is problematic to use the published standardization norms in the manual. The use of such non-local norms for this particular test, or the use of local norms that are not stratified by age and quality of education, for participants matching the demographic profile of this study sample, is likely to increase the risk of false-positive diagnoses of dysfunctional abilities in the domains of visual attention, attentional control, and cognitive flexibility.

3.1.2. The Children’s Memory Scales (CMS) Numbers Subtest

3.1.2.1. CMS Numbers: Relative influences of sociodemographic factors and stratified norms

Table 14. *CMS Numbers Analyses of Covariance: Effects of age, sex, language, and quality of education*

	Numbers Forward			Numbers Backward		
	F	*p*	ω^2	*F*	*p*	ω^2
Main Effect						
Age	1.01	.317	.005	7.99	**.005**	.037
Sex	0.18	.668	.001	0.99	.320	.005
Language	18.49	**< .001**	.082	5.76	**.017**	.027
Quality of Education	16.79	**< .001**	.075	22.38	**< .001**	.098
Interaction Effect						
Sex x Language	2.74	.099	.013	0.18	.673	.001
Sex x Quality of Education	0.01	.995	.000	0.51	.478	.002
Language x Quality of Education	3.57	.060	.017	0.08	.774	.000
Sex x Language x Quality of Education	3.95	.058	.019	0.21	.649	.001

Tables 14 and 15 show that the relative influences of sociodemographic variables affected performance on the CMS Numbers Forward and Backward Subtests differently. This seems to support evidence that the two outcome variables measure different aspects of memory, and that it is not clinically useful to report them as a composite score (Banken, 1985; E. Kaplan et al., 1991; Lezak et al., 2004; Rudel & Denckla, 1974; Strauss et al., 2006).

The ability to encode new verbal information, as measured by Numbers Forward, was adversely affected by Afrikaans language, disadvantaged quality of education, and coloured race (for participants with advantaged education). Age, sex, and interaction effects were not significant (see Tables 14 to 16). Within the whole sample, language and quality of education accounted for a similar portion of variance in scores (8.2% and 7.5% respectively). Within the group with advantaged quality of education, language (12.0%) and race (12.6%) made similar contributions to the variance.

Table 15. *CMS Numbers Analyses of Variance: Between-race comparisons for participants with advantaged quality of education*

Outcome Measure	**Race**						**ANOVA Test Statistics**	
	Coloured			**White**				
	n	***M***	***SD***	***n***	***M***	***SD***	***F***	***p***
Numbers Forward	27	8.96	2.75	67	10.22	2.06	5.91	**.017**
Numbers Backward	27	5.67	2.29	67	5.90	1.96	0.24	.627

Note. Data are presented in raw scores.

Table 16. *CMS Numbers Forward Analyses of Covariance for Participants with Advantaged Quality of Education: Effects of age, sex, language, and race*

	Numbers Forward		
	F	***p***	ω^2
Main Effect			
Age	1.63	.097	.082
Sex	1.44	.234	.016
Language	11.71	**.001**	.120
Race	12.40	**.001**	.126
Interaction Effect			
Sex x Language	0.02	.885	.000
Sex x Race	0.36	.550	.004
Language x Race	3.20	.077	.036
Sex x Language x Race	0.02	.985.	.001

Poorer working memory, as measured by Numbers Backward, was predicted by younger age, Afrikaans language, and disadvantaged quality of education, but not associated with sex or race (for participants with disadvantaged quality of education) (see Tables 14 to 16). When other covariates were held constant, quality of education accounted for the largest percentage (9.8%) or variance in scores, followed by age (3.7%), and language (2.7%). While age and language contributed to a relatively small portion of variance in scores (3.7% and 2.7%, respectively), quality of education (9.8%) appeared to be more influential. Because age significantly predicted performance on Numbers Backward, it was necessary to determine how to cluster age-groups for the normative data. Although the post-hoc analyses did not demonstrate significant differences in mean scores between the four age-groups (see Table 17), the means plot showed an upward shift in performance between 12- to 14- year-olds, and 15-year-olds (see Figure 3).

Table 17. *CMS Numbers Backward Post-hoc LSD Analyses: Mean differences for age-group comparisons*

Age (years)	**Mean Difference**	***p***
12 vs 13	0.21	.585
12 vs 14	0.01	.978
12 vs 15	0.60	.086
13 vs 14	0.20	.623
13 vs 15	0.40	.302
14 vs 15	0.59	.112

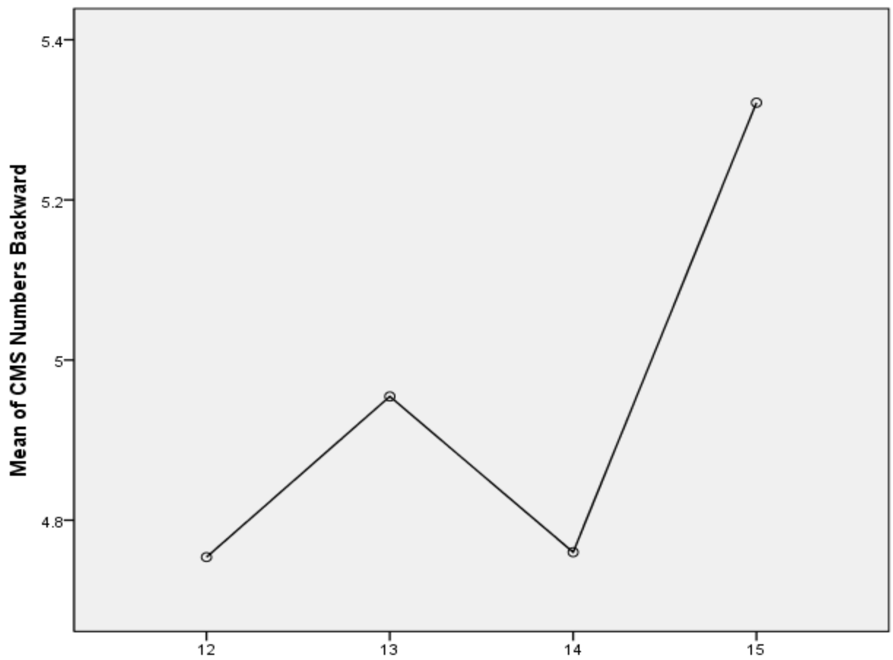

Figure 3. CMS Numbers Backward means plot by age-group.

In keeping with the findings described above, I presented normative data for Numbers Forward for a single 12- to 15-year-old age-group, stratified by language, quality of education, and race (see descriptive norms in Table 18 and norm conversion Tables D-9 to D-14 in Appendix D). Because of the small cell sizes for the Afrikaans-advantaged subgroup, generalizability to the general population meeting this sociodemographic profile is limited. I recommend that alternative measures of encoding of verbal information are employed as collateral sources of information. It would be beneficial to extend the database for coloured and white, Afrikaans-speakers with advantaged quality of education, in future studies.

Table 18. *CMS Numbers Forward Descriptive Normative Data: Stratified by language, race (for participants with advantaged quality of education), and quality of education*

Language	**Race**	**Quality of Education**	***n***	***M***	***SD***	**Range**
Afrikaans	Coloured	Advantaged	6	7.77	2.86	1 - 9
		Disadvantaged	77	7.62	1.56	4 - 11
	White	Advantaged	10	9.40	1.17	8 - 11
English	Coloured	Advantaged	21	9.76	2.19	6 - 13
		Disadvantaged	57	10.37	2.15	6 - 14
	White	Advantaged	44	8.41	1.76	5 - 12

Note. Data are presented in raw scores; the sample (N = 215) included female and male participants.

I stratified the Numbers Backward norms by two age-groups (i.e., 12- to 14-year-olds, and 15-year-olds), language, and quality of education (see descriptive norms in Table 19 and conversion Tables 15 to 22 in Appendix D). Because the data were stratified by three sociodemographic variables, some of the cell sizes were small. Consequently, data for 15-year-olds (particularly Afrikaans-advantaged, and English-disadvantaged subgroups) and 12- to 14-year-old, Afrikaans-advantaged participants, need to be interpreted with due caution.

Table 19. *CMS Numbers Backward Descriptive Normative Data: Stratified by age, language, and quality of education*

Age (years)	**Language**	**Quality of Education**	***n***	**M**	**SD**	**Range**
12 to 14	Afrikaans	Advantaged	12	4.83	1.64	2 – 8
		Disadvantaged	50	3.98	1.44	2 – 9
	English	Advantaged	63	5.68	1.99	2 – 11
		Disadvantaged	34	4.41	1.35	2 - 7
15	Afrikaans	Advantaged	4	6.75	0.96	6 – 8
		Disadvantaged	27	4.15	1.32	2 – 7
	English	Advantaged	15	7.00	2.30	4 – 12
		Disadvantaged	27	4.15	1.32	2 - 7

Note. Data are presented in raw scores; the sample (N = 215) included female and male participants; groups with advantaged quality of education included coloured and white participants; groups with disadvantaged quality of education which included coloured participants.

The findings of my study are consistent with trends reported in the literature regarding digit span tasks (similar to CMS Numbers) in that forward-span tasks are easier than backward-span tasks (Cohen, 1997; Lezak et al., 2004; Strauss et al., 2006). The absence of sex-related differences in performances on both Numbers tasks in this study is also consistent with meta-analytic data for digit span tasks in children and adolescents (Lynn & Irwing, 2008).

The findings from this study are consistent with other findings in that performance on the Numbers Forward Subtest is stable between the ages of 12 and 15 years (Conklin et al., 2007). Conklin et al (2007) found that performance on Numbers Backward continued to improve through adolescence, stabilizing at the age of 17. Within the language-quality of education subgroups, the results from this study tend to indicate a developmental shift after the age of 14. Future studies are necessary to determine the age at which performance on this task stabilizes in the local population.

The lowered scores attained by participants with disadvantaged quality of education in this study are also consistent with previous findings. For example, Ostrosky-Solis et al. (Ostrosky-Solis & Asucena, 2006) demonstrated that poorer digit span was associated with lower levels of parental education, lower literacy levels and poorer quality of education in participants. Cash (2007) found that performance on the CMS Numbers by children with Hispanic and African-American heritage was worse than those with American-white parents.

The results of this study are consistent with other findings regarding the associations between sociodemographic factors (language, quality of education and race) and performance on digit span tasks in South African adolescents. For example, Shuttleworth-Edwards et al. (in press) demonstrated a downward trend in performance in 12- to 13-year olds, with white-English-advantaged participants attaining the highest scores, followed by white-Afrikaans-advantaged, then coloured-Afrikaans-advantaged, and the poorest performances were exhibited by the coloured-Afrikaans-disadvantaged group. Although not directly comparable, because the aforementioned study reported digit span as a composite variable, the trends regarding the relationship between sociodemographic factors and digit span are similar to our findings. For example, on Numbers Forward, white participants who were English fared better than Afrikaans-speakers; and white participants achieved higher scores than coloured participants. For both Numbers Forwards and Backwards, there was a pervasive pattern of poorer performance by participants with disadvantaged (vs advantaged) quality of education.

3.1.2.2. CMS Numbers: Cross-cultural comparison of norms

I compared the local norms with Cohen's (1997) normative data derived from the USA standardization study of the CMS. It was not possible to calculate effect sizes or to ascertain clinical significances in terms of SD differences, because the SDs for Numbers Forward and Numbers Backward are not cited in Cohen's manual. Consequently, I described general qualitative trends with regard to mean differences between non-local and local norms. For t-test calculations, I used the 50th percentile raw scores to reflect the means for the age-groups as published in Cohen's manual (see Tables 20 and 21).

Table 20. *CMS Numbers Forward Cross-Cultural Utility: Comparisons between local and non-local norms*

Cohen (1997) USA Standardization Smoothed Norms			**Western Cape Norms***						**T-test Statistics**		
Age	***n***	**50th %ile**	**Lang**	**Race**	**Q Ed**	***n***	***M***	***SD***	**Mean Diff**	***t***	***p***
12	100	9	Afr	Col	Adv	0	-	-	-	-	-
					Dis	23	8.39	1.44	-0.61	-2.03	.055
				White	Adv	2	9.50	2.12	0.50	0.33	.795
			Eng	Col	Adv	4	8.50	2.38	-0.50	-0.42	.703
					Dis	11	7.36	1.29	-1.64	-4.22	**.002**
				White	Adv	25	9.68	1.95	0.68	1.74	.094
13 to 14	100	10	Afr	Col	Adv	4	5.25	3.10	-4.75	-3.07	.055
					Dis	28	7.18	1.66	-2.82	-9.01	**< .001**
				White	Adv	6	9.33	1.21	-0.67	-1.35	.235
			Eng	Col	Adv	9	9.78	2.73	-0.22	-0.24	.813
					Dis	23	8.52	1.68	-1.48	-4.23	**< .001**
				White	Adv	25	10.64	1.98	0.64	1.62	.119
15 to 16	100	10	Afr	Col	Adv	2	8.00	1.41	-2.00	-2.00	.295
					Dis	26	7.42	1.33	-2.58	-9.87	**< .001**
				White	Adv	2	9.50	0.71	-0.50	-1.00	.500
			Eng	Col	Adv	8	10.38	1.19	0.38	0.89	.402
					Dis	7	11.86	2.73	1.86	1.80	.122
				White	Adv	10	9.30	1.95	-0.70	-1.14	.285

Note. Data are presented in raw scores; *the sample (N = 215) included female and male participants; Q Ed = Quality of Education; Lang = Language; Afr = Afrikaans; Eng = English; Adv = advantaged quality of education; Dis = disadvantaged quality of education; Col = coloured participants.

Table 21. *CMS Numbers Backward Cross-Cultural Utility: Comparisons between local and non-local norms*

Cohen (1997) USA Standardization Smoothed Norms			**Western Cape Norms***					**T-test Statistics**		
Age	***n***	**50th %ile**	**Language**	**Q Ed**	***n***	***M***	***SD***	**Mean Diff**	***t***	***p***
12	100	5	Afrikaans	Adv	2	4.50	0.71	-0.50	-1.00	.500
				Dis	23	3.89	1.30	-1.17	-4.32	**< .001**
			English	Adv	29	5.66	1.84	0.66	1.92	.065
				Dis	11	4.36	1.36	-0.64	-1.55	.152
13 to 14	100	6	Afrikaans	Adv	10	4.90	1.79	-1.10	-1.94	.084
				Dis	28	4.11	1.52	-1.89	-6.57	**< .001**
			English	Adv	34	5.71	2.15	-0.29	-0.80	.432
				Dis	23	4.43	1.38	-1.57	-5.46	**< .001**
15 to 16	100	7	Afrikaans	Adv	4	6.75	0.96	-0.25	-0.52	.638
				Dis	26	4.15	1.35	-2.85	-10.77	**< .001**
			English	Adv	15	7.00	2.30	0.00	0.00	1.00
				Dis	10	5.40	1.90	-1.60	-2.67	**.026**

Note. Data are presented in raw scores; *the sample (N = 215) included female and male participants; Adv = groups with advantaged quality of education, which included coloured and white participants; Dis = groups with disadvantaged quality of education, which included coloured participants.

Overall trends indicated that our participants with disadvantaged quality of education attained significantly lower scores than their American age-related peers, regardless of test language. On the other hand, the American normative data were compatible with the local data for participants with advantaged quality of education. The implications of these findings are that the use of Cohen's norms are inappropriate for coloured participants with disadvantaged quality of education, as they are likely to underestimate true encoding and working memory abilities, and carry an increased risk of false positive misdiagnoses.

However, for English- and Afrikaans-speaking, white and coloured participants with advantaged quality of education, the use of non-local norms would not be inappropriate for 12- to 15-year-olds. It would be useful to investigate whether Cohen's norms would also be acceptable for cross-cultural use for 8- to 11-year-olds matching the sociodemographic profile of the advantaged subgroup in this study.

3.1.3. Children's Memory Scales (CMS) Stories Subtest

3.1.3.1. CMS Stories: Relative influences of sociodemographic factors and stratified norms

Tables 22 to 24 show that, for all outcome variables of the Stories Subtest, multiple main effects, and three-way interaction effects were statistically significant. It was thus impossible to meaningfully disentangle the relative effects of the sociodemographic variables (age, sex, language, quality of education, race, and the interactions between these covariates) on cognitive test performance. Consequently, I did not stratify normative data, or create normative conversion tables.

The CMS Stories Subtest is problematic in our context, not only for statistical reasons, but for numerous other reasons as well. From the testers' perspective, these subtests earned notoriety as *morale-breakers*. Testers reported that many of the participants struggled with these tests, and appeared to "switch off" after the first few sentences of each story. Given that the participants remained focused and engaged for the other verbal memory tests (and the rest of the compendium), I surmise that it is more likely that the problem lay with the tests rather than the participants.

Table 22: *CMS Stories Analyses of Variance: Between-race comparisons for participants with advantaged quality of education*

Outcome Measure	**Race**						**ANOVA Test Statistics**	
	Coloured			**White**				
	n	***M***	***SD***	***n***	***M***	***SD***	***F***	***p***
Immediate Recall of Story Units	27	38.56	14.56	67	47.79	13.75	8.40	**.005**
Immediate Recall of Thematic Units	27	6.78	2.59	67	8.10	2.82	4.46	**.037**
Delayed Recall of Story Units	27	36.26	13.63	67	44.19	13.90	6.34	**.014**
Delayed Recall of Thematic Units	27	6.56	2.68	67	7.75	2.78	3.81	.047
Recognition	27	23.56	3.00	67	25.60	3.23	8.00	**.006**

Note. Data are presented in raw scores.

Table 23. *CMS Stories Analyses of Covariance: Effects of age, sex, language, and quality of education*

Story Units	**Immediate Recall**			**Delayed Recall**		
	F	***p***	ω^2	***F***	***p***	ω^2
Main Effect						
Age	4.22	**.041**	.020	5.79	**.017**	.027
Sex	0.26	.614	.001	0.01	.980	.000
Language	3.33	.069	.016	5.04	**.026**	.024
Quality of Education	38.68	**< .001**	.158	38.33	**< .001**	.157
Interaction Effect						
Sex x Language	5.48	**.020**	.026	4.33	**.039**	.021
Sex x Quality of Education	3.48	.063	.017	2.27	.133	.011
Language x Quality of Education	3.33	.070	.016	3.64	**.048**	.017
Sex x Language x Quality of Education	6.74	**.010**	.032	5.46	**.020**	.026
Thematic Units	**Immediate Recall**			**Delayed Recall**		
	F	***p***	ω^2	***F***	***p***	ω^2
Main Effect						
Age	12.57	**< .001**	.058	12.39	**.001**	.057
Sex	0.13	.717	.001	0.14	.707	.001
Language	0.60	.440	.003	1.08	.299	.005
Quality of Education	45.97	**< .001**	.182	45.09	**< .001**	.180
Interaction Effect						
Sex x Language	4.03	**.046**	.019	1.46	.228	.007
Sex x Quality of Education	3.96	**.048**	.019	2.23	.137	.011
Language x Quality of Education	2.28	.133	.011	2.29	.132	.011
Sex x Language x Quality of Education	7.58	**.006**	.035	8.78	**.003**	.041

	Recognition		
	F	***p***	ω^2
Main Effect			
Age	7.27	**.008**	.034
Sex	0.57	.452	.003
Language	0.01	.941	.000
Quality of Education	53.35	**< .001**	.206
Interaction Effect			
Sex x Language	3.08	.081	.015
Sex x Quality of Education	3.85	**.041**	.018
Language x Quality of Education	0.01	.911	.000
Sex x Language x Quality of Education	5.71	**.018**	.027

Table 24. *CMS Stories Analyses of Covariance for Participants with Advantaged Quality of Education: Effects of age, sex, language, and race*

Story Units	**Immediate Recall**			**Delayed Recall**		
	F	p	ω^2	F	p	ω^2
Main Effect						
Age	7.80	**.006**	.083	10.53	**.002**	.109
Sex	0.27	.605	.003	0.07	.788	.001
Language	8.91	**.004**	.094	8.10	**.006**	.086
Race	7.90	**.006**	.084	5.01	.028	.055
Interaction Effect						
Sex x Language	0.87	.354	.010	1.38	.243	.016
Sex x Race	0.82	.367	.009	0.19	.666	.002
Language x Race	2.14	.148	.024	0.23	.635	.003
Sex x Language x Race	4.01	**.001**	.246	3.87	**.001**	.239
Thematic Units	**Immediate Recall**			**Delayed Recall**		
	F	p	ω^2	F	p	ω^2
Main Effect						
Age	12.49	**.001**	.127	11.09	**.001**	.114
Sex	0.86	.357	.010	0.78	.379	.009
Language	6.38	**.013**	.069	6.48	**.013**	.070
Race	7.68	**.007**	.082	5.15	**.026**	.057
Interaction Effect						
Sex x Language	0.39	.534	.005	0.39	.535	.004
Sex x Race	1.60	.210	.018	1.82	.180	.021
Language x Race	4.53	**.036**	.050	2.91	.092	.033
Sex x Language x Race	3.88	**.001**	.240	3.20	**.005**	.206

	Recognition		
	F	p	ω^2
Main Effect			
Age	4.32	**< .001**	.260
Sex	9.12	**.003**	.096
Language	2.21	.141	.025
Race	3.93	.051	.044
Interaction Effect			
Sex x Language	13.12	**.000**	.132
Sex x Race	0.04	.834	.001
Language x Race	5.84	**.018**	.064
Sex x Language x Race	10.10	**.002**	.105

I listed the descriptive statistics for the whole study sample in Table 25. However, due to the complex interaction effects between covariates, the means and standard deviations provided should not be interpreted as normative data for clinical or research purposes.

Table 25. *CMS Stories Descriptive Data*

Outcome Measure	***n***	***M***	***SD***	**Range**
Immediate Recall of Story Units	215	36.34	15.74	5 – 74
Immediate Recall of Thematic Units	215	6.06	3.05	0 – 13
Delayed Recall of Story Units	215	33.30	15.21	1 – 73
Delayed Recall of Thematic Units	215	5.72	3.06	0 – 13
Recognition	215	22.91	3.75	13 - 30

Note. Data are presented in raw scores; the sample (N = 215) included coloured and white, 12- to 15-year-old, female and male, Afrikaans- and English-speaking participants with advantaged and disadvantaged quality of education.

The results suggest that retaining the original story content (with minor contextual alterations in terminology) proved to be inadequate to reduce cultural bias. Stories E and F from the CMS Subtest seem to contain too many units of information and too many concepts and terms that are “foreign” to South Africans. It appeared that the intended overload on the memory system was, in fact, too taxing. Because it is more difficult to remember information that is difficult to comprehend (Hemp, 2008), there is the strong possibility that the complexity of the stories interferes with the subtest’s capacity to measure memory. From a clinical or research interpretive perspective, it is thus questionable whether performance on these particular stories actually reflects memory functioning.

3.1.3.2. CMS Stories Subtest: Cross-cultural comparison of norms

The t-test comparisons between the means from the study sample and Cohen’s (1997) USA standardization norms showed that the use of the latter norms for the local population would be highly problematic (see Table 25). From a statistical perspective, the CMS Stories Subtest is most distinctively not a useful measure of verbal memory for participants matching the sociodemographic profile of the study sample.

Table 26. *CMS Stories Cross-Cultural Utility: Comparisons between local and non-local norms*

Cohen (1997) USA Standardization Smoothed Norms				Western Cape Norms*			T-test Statistics		
Outcome Measure	**Age (years)**	***n***	**50th %ile**	***n***	**M**	**SD**	**Mean Diff**	***t***	***p***
Immediate Recall of Story Units	12	100	56	65	35.68	15.98	-20.32	-10.42	**< .001**
	13 to 14	100	40	95	35.91	14.83	-4.10	-2.69	**.008**
	15 to 16	100	41	55	37.87	17.11	-3.13	-1.36	**.049**
Immediate Recall of Thematic Units	12	100	10	65	5.45	3.19	-4.55	-11.51	**< .001**
	13 to 14	100	7.5	95	6.14	2.85	-1.36	-4.67	**< .001**
	15 to 16	100	7.5	55	6.65	3.15	-0.85	-1.99	**.049**
Delayed Recall of Story Units	12	100	54	65	31.92	15.48	-22.08	-11.50	**< .001**
	13 to 14	100	37	95	33.65	14.43	-3.35	-2.26	**.026**
	15 to 16	100	38	55	34.81	16.31	-3.69	-1.68	**.048**
Delayed Recall of Thematic Units	12	100	10	65	5.06	3.31	-4.94	-12.02	**< .001**
	13 to 14	100	7	95	5.86	2.93	-1.14	-3.78	**< .001**
	15 to 16	100	7	55	6.24	2.89	-0.76	-1.96	**.049**
Recognition	12	100	26	65	22.22	3.76	-3.79	-8.11	**< .001**
	13 to 14	100	25	95	23.25	3.68	-1.75	-4.63	**< .001**
	15 to 16	100	25	55	23.15	3.80	-1.86	-3.62	**.001**

Note. Data are presented in raw scores; *the sample (N = 215) included coloured and white, female and male, Afrikaans- and English-speaking, with advantaged and disadvantaged quality of education.

Clinicians are dissuaded from using the CMS Stories E and F in the described population. I suggest that these stories may be similarly incomprehensible for South Africans other than the specified study sample as well, but it would be necessary to verify this empirically. I recommend the MAVLT as a more suitable measure of verbal memory in the local context.

For the purposes of assessing verbal memory embedded in a semantic context, I suggest investigating the utility of other stories. Examples of stories that may be more suitable include the stories prescribed for younger children in the CMS (Cohen, 1997), or a story designed by Frances Hemp for use in the Western Cape Province (Hemp, 2010). However, it would be necessary to empirically establish whether alternative stories are more suitable for assessing verbal memory in the local context.

3.1.4. The CLOX Test

3.1.4.1. CLOX: Relative influences of sociodemographic factors and stratified norms

For both trials of the CLOX Test, performance was predicted by only one covariate (see Table 27). When the effects of age, sex, language, and interaction effects were held constant, disadvantaged quality of education predicted lower scores on Trial 1 (as a measure of goal-setting).

Table 27. *CLOX Analyses of Covariance: Effects of age, sex, language, and quality of education*

	Trial 1			Trial 2		
	F	***p***	ω^2	***F***	***p***	ω^2
Main Effect						
Age	0.14	.708	.001	0.22	.642	.001
Sex	0.04	.840	.000	3.99	**.047**	.019
Language	0.35	.553	.002	0.69	.407	.003
Quality of Education	8.21	**.005**	.038	2.04	.154	.010
Interaction Effect						
Sex x Language	0.82	.366	.004	0.03	.859	.000
Sex x Quality of Education	0.02	.886	.000	1.19	.277	.006
Language x Quality of Education	0.61	.435	.003	0.01	.970	.000
Sex x Language x Quality of Education	1.87	.174	.009	0.32	.575	.002

Male sex predicted marginally lower performance in visuospatial ability, as measured by CLOX Trial 2, but all other sociodemographic and interaction effects were not significant. For the subgroup with advantaged quality of education, mean differences in performance between coloured and white participants on both CLOX tasks were non-significant (see Table 28).

Table 28. *CLOX Analyses of Variance: Between-race comparisons for participants with advantaged quality of education*

Outcome Measure	**Race**						**ANOVA Test Statistics**	
	Coloured			**White**				
	n	***M***	***SD***	***n***	***M***	***SD***	***F***	***p***
Trial 1	27	12.59	1.31	67	13.00	1.34	1.81	.182
Trial 2	27	13.85	0.99	67	14.03	1.04	0.58	.450

Because age and race effects on both CLOX trials were non-significant, no further post-hoc analyses were necessary. I stratified the norms for Trial 1 by quality of education (see Table 29), and for Trial 2 by sex (see Table 30). Cell sizes were thus sufficiently large to allow for meaningful generalization to the population. Appropriately stratified normative conversion tables are located in Appendix D (Tables D-23 to D-26).

Table 29. *CLOX Trial 1 Descriptive Normative Data: Stratified by quality of education*

Quality of Education	***n***	***M***	***SD***	**Range**
Advantaged	94	12.88	1.34	10 – 14
Disadvantaged	121	12.27	1.63	4 - 15

Note. The sample (*N* = 215) included 12- to 15-year-old, female and male, Afrikaans- and English-speaking participants; the group with advantaged quality of education included coloured and white participants; the group with disadvantaged quality of education included coloured participants.

Table 30. *CLOX Trial 2 Descriptive Normative Data: Stratified by sex*

Sex	***n***	***M***	***SD***	**Range**
Female	117	14.00	0.98	11 – 15
Male	98	13.56	1.11	10 - 15

Note. The sample (*N* = 215) included 12- to 15-year-old, Afrikaans- and English-speaking participants; the group with advantaged quality of education included coloured and white participants; the group with disadvantaged quality of education included coloured participants.

The findings from this study are consistent with findings relative to other clock drawing tasks, in that performance on the copy task tends to be better than on the drawing task (Dilworth et al., 2004). Although the mean differences in quality of education (Trial 1 SD = 1.53) and sex (Trial 2 SD = 1.06) were statistically significant, they were not clinically significant relative to the whole sample.

These findings suggest that CLOX Trial 1 may be clinically useful as a quick, free and easy screening device for executive dysfunction, specifically with regard to goal setting, planning and organization (Royall et al., 1998; Royall et al., 2004).

Future studies of clinical samples with ADHD, for example, would be useful to determine the clinical utility of the task of this specific clock drawing task in the local population (Kibby et al., 2001). The findings also demonstrate that the CLOX Trial 2 is a culture-friendly non-speeded measure of visuospatial ability which is well suited to the local population.

3.1.4.2. CLOX: Cross-cultural comparison of norms

Because I was unable to source any normative data for the CLOX Test for the adolescent population, I used Royall and colleagues' (1998) original normative data for 20- to 28-year-olds from the USA (see Table 31).

Table 31. *CLOX Cross-Cultural Utility: Comparisons between local and non-local norms*

Royall et al (1998) USA norms for young adults				**Western Cape Norms***				**T-test Statistics**			
Age	***n***	***M***	***SD***	**Group**	***n***	***M***	***SD***	**Mean Diff**	***t***	***p***	***ESE***
Trial 1											
20 to 28	45	13.2	1.6	Adv	94	12.88	1.33	-0.32	-2.30	**.024**	0.22
				Dis	121	12.27	1.63	-0.93	-6.27	**< .001**	0.57
Trial 2											
20 to 28	45	14.2	1.6	Female	117	13.99	0.98	-0.21	-2.31	**< .023**	0.18
				Male	98	13.56	1.11	-0.64	-5.68	**< .001**	0.50

Note. ESE = Hedges' *g* effect size estimate; *the sample (*N* = 215) included 12- to 15-year-old, female and male, Afrikaans- and English-speaking participants; Adv = the group with advantaged quality of education, which included coloured and white participants; Dis = the group with disadvantaged quality of education, which included coloured participants.

The absence of age-related differences in performances on both CLOX tasks in our sample is consistent with literature that demonstrates that clock drawing performance tends to improve between the ages of 6 and 12, then to stabilize during adolescence (Bozikas et al., 2008). However, the differences in performance between our sample of adolescents, and Royall et al.'s (1998) young adult sample suggest that further increments in performance may occur after the age of 15, which would need to be validated in further studies.

The lower scores in our sample, relative to Royall et al.'s norms were statistically significant, but effect sizes were small for the advantaged group in Trial 1, and for the female group in Trial 2; or moderate for the disadvantaged group (Trial 1), and for the male group (Trial 2). All the mean differences listed in Table 30 were less than 1 SD and thus clinically non-significant. Overall, our findings are consistent with literature that promotes the CLOX tests as a relatively culture-fair instrument, as evinced in Chinese Singaporean (Yap et al., 2007); and Hispanic adults (Royall et al., 2003).

3.1.5. Grooved Pegboard Test (GPT)

3.1.5.1. GPT: Relative influences of sociodemographic factors and stratified norms

Table 32. *GPT Analyses of Covariance: Effects of age, sex, language, and quality of education on completion times (in seconds)*

	GPT1 Peg Insertion Dominant Hand			GPT1 Peg Insertion Nondominant Hand		
	F	*p*	ω^2	*F*	*p*	ω^2
Main Effect						
Age	18.77	**< .001**	.084	15.86	**< .001**	.072
Sex	2.23	.137	.011	0.40	.527	.002
Language	0.27	.606	.001	1.26	.262	.006
Quality of Education	7.52	**.007**	.035	13.29	**< .001**	.061
Interaction Effect						
Sex x Language	0.18	.669	.001	1.73	.189	.008
Sex x Quality of Education	0.32	.574	.002	0.68	.412	.003
Language x Quality of Ed	0.01	.925	.000	2.75	.099	.013
Sex x Language x Quality of Ed	0.66	.418	.003	0.38	.539	.002
	GPT2 Peg Removal Dominant Hand			**GPT2 Peg Removal Nondominant Hand**		
	F	*p*	ω^2	*F*	*p*	ω^2
Main Effect						
Age	0.31	.581	.001	0.75	.389	.004
Sex	1.97	.162	.009	1.01	.317	.005
Language	0.88	.351	.004	1.69	.196	.008
Quality of Education	3.64	.058	.017	0.14	.706	.001
Interaction Effect						
Sex x Language	0.38	.540	.002	1.04	.308	.005
Sex x Quality of Education	3.86	.051	.018	1.03	.312	.005
Language x Quality of Ed	0.43	.511	.002	1.59	.209	.008
Sex x Language x Quality of Ed	0.06	.809	.000	0.56	.448	.003

The two trials of the GPT both measure manual dexterity, but in accordance with Bryden and Roy's recommendations (2005), I used the peg insertion task (GPT1) as a measure of visuomotor ability (i.e., fine motor coordination), and the peg removal task (GPT2) to measure psychomotor speed. I excluded data (n = 21) from left-handed (n = 11) and ambidextrous (n = 10) participants (as measured by the Edinburgh Handedness Inventory), to avoid handedness as a potential confound (Bryden & Roy, 2005; Mitrushina et al., 2005), resulting in a reduced sample size (*N* = 194) (See Table 2).

The results shown in Table 32 show that for GPT1, younger age and disadvantaged quality of education predicted poorer outcome (i.e., slower completion times) for fine motor coordination. Age contributed to a larger portion of the variance (8.4% for the dominant hand, and 7.2% for the nondominant hand) in outcome scores than quality of education (3.5% and 6.1% for dominant and nondominant hand, respectively).

There were no significant main or interaction effects on performance for the GPT2. For participants with advantaged quality of education, race did not predict outcome over and above the other covariates for either GPT tasks in either the dominant or nondominant hand (see Table 33), obviating the necessity for further race-related analyses.

Table 33. *GPT Analyses of Variance: Between-race comparisons for participants with advantaged quality of education on completion times (in seconds)*

Outcome Measure	**Race**						**ANOVA Test Statistics**	
	Coloured			**White**				
	n	***M***	***SD***	***n***	***M***	***SD***	***F***	***p***
GPT1 Dominant	27	69.22	9.71	67	68.90	8.49	0.03	.872
GPT1 Nondominant	27	77.19	10.29	67	75.19	11.33	0.63	.431
GPT2 Dominant	27	23.59	3.10	67	23.99	4.27	0.19	.666
GPT2 Nondominant	27	25.67	11.70	67	24.22	4.26	0.78	.381

Note. GPT1 = peg insertion; GPT2 = peg removal.

Because age was shown to be associated with performance for both hands on GPT1 (see Table 32), it was necessary to determine how to cluster age-groups for the normative data. The results of the consequent post-hoc LSD analyses (see Table 34) and means plots (see, e.g., Figure 4) demonstrated a stepwise improvement in performance (i.e., decrease in speed) between 12- to 13-year-olds and 14- to 15-year-olds.

Table 34. *GPT1 Post-hoc LSD Analyses: Mean differences for age-group comparisons on completion times*

Age (years)	Dominant Hand		Nondominant Hand	
	Mean Difference	*p*	Mean Difference	*p*
12 vs 13	2.18	.270	-2.29	.394
12 vs 14	5.03	**.009**	7.02	**.007**
12 vs 15	6.27	**.001**	7.07	**.005**
13 vs 14	2.85	.174	9.31	**.001**
13 vs 15	4.09	**.045**	9.37	**.001**
14 vs 15	1.24	.529	0.06	.983

Note. Completion time data are presented in seconds.

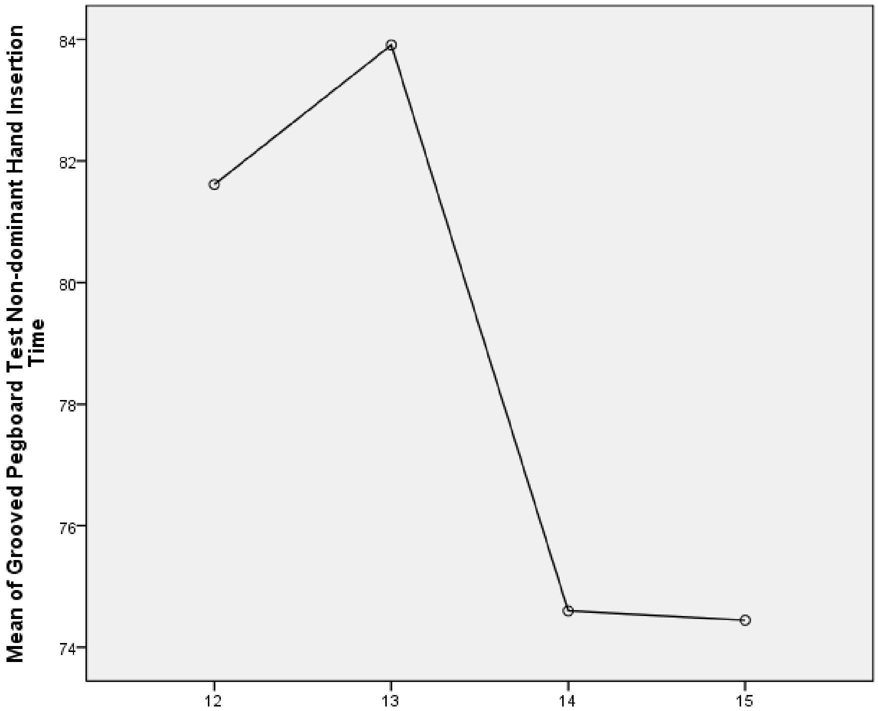

Figure 4. GPT1 means plot by age-group for peg insertion completion time with the nondominant hand.

Given the data summarized above, the descriptive normative data for GPT1 (see Table 35) were stratified by two age-groups (viz., 12 to 13 years; and 14 to 15 years), and by quality of education. Table 35 also presents norms for the entire right-handed sample (N = 194) for GPT2 (because none of the sociodemographic variables were associated with completion times), and for intermanual differences on GPT1 and GPT2 (because these data were non-normally distributed). Norm conversion tables for completion times are located in Appendix D (GPT1: Tables D-27 to D-34; GPT2: Tables D-35 to D-36).

Table 35. *GPT Descriptive Normative Data: Stratified by age and quality of education for peg insertion completion times; and for the whole sample for peg removal completion times, and intermanual differences*

Age (years)	Qual Ed	*n*	*M*	*SD*	Range	*n*	*M*	*SD*	Range
GPT1		**Dominant Hand**				**Nondominant Hand**			
12 to 13	Adv	54	71.07	8.21	58 - 96	54	78.59	10.59	56 - 103
	Dis	47	74.49	13.35	50 - 120	47	84.49	10.31	65 - 102
14 to 15	Adv	30	67.47	8.77	49 - 81	30	72.93	10.61	51 - 88
	Dis	63	69.27	8.32	53 - 94	63	76.24	13.93	22 - 113
GPT1 Intermanual Differences									
12 to 15		194	7.62	11.48	-48 - 38				
GPT2		**Dominant Hand**				**Nondominant Hand**			
12 to 15		194	24.85	6.64	14 - 82	194	25.02	5.81	12 - 82
GPT2 Intermanual Differences									
12 to 15		194	0.16	7.91	-61 - 62				

Note. Completion time data are presented in seconds; the whole sample (*N* = 194) included right-handed, female and male, Afrikaans- and English-speaking participants; Qual Ed = quality of education; Adv = groups with advantaged quality of education, which included coloured and white participants; Dis = groups with disadvantaged quality of education, which included coloured participants.

Within groups with advantaged and disadvantaged quality of education, age-group differences were statistically but not clinically significant for GPT1. Within the group with advantaged quality of education, the mean differences (3.60 seconds for dominant hand and 5.66 seconds for nondominant hand) between 12- to 13-year-olds and 14- to 15-year-olds were considerably smaller than one SD (dominant hand SD = 11.25; nondominant SD = 16.11), and consequently clinically inconsequential. Within the group with disadvantaged quality of education, the mean differences (5.22 and 8.25 seconds for dominant and nondominant hands, respectively) between the younger and older age-groups also did not exceed one SD (dominant hand SD = 8.80; nondominant hand SD = 11.02).

Previous literature has reported that GPT1 speed increases gradually though childhood, but tends to stabilize during adolescence (Rosselli et al., 2001; Trites, 1977). Our findings suggest ongoing refinement during adolescence for the GPT1 and stabilized performance for GPT2. Our findings are consistent with previous literature indicating that completion times for the dominant hand are faster than the nondominant hand (Mitrushina et al., 2005). The absence of sex differences in GPT1 performance in this study is also consistent with pre-existing literature (Rosselli et al., 2001; Thompson et al., 1987), but contrast Bryden and Roy's (2005) isolated findings of female superiority in GPT2.

3.1.5.2. GPT: Cross-cultural comparison of norms

In order to investigate the cross-cultural utility of the Western Cape GPT norms derived from the current data, I did not use the Trites' (1977) original Canadian standardization norms, as the scoring system for these differed from the one used in my study. I used the "miscellaneous" reference data published in the GPT manual (Lafayette Instrument Company, 2003, p. 8), which are listed by age, and use a scoring system in which completion time in seconds is used without adding the number of pegs dropped or the number of pegs correctly placed. The sampling details of the data in the manual are not provided, although the reference list includes studies located in the USA and Canada. For this comparison, I used the four age-group divisions that were used in the manual, and I stratified each age-group by quality of education (see Table 36).

Table 36. *GPT1 Cross-Cultural Utility: Comparisons between local and non-local norms for peg insertion completion time*

Lafayette (2008) Miscellaneous Norms			**Western Cape Norms***				**T-test Statistics**			
Age	***n***	***M (SD)***	***Q Ed***	***n***	***M***	***SD***	**Mean Diff**	***t***	***p***	***ESE***
Dominant Hand										
12	53	65.07	Adv	30	71.07	1.35	5.99	4.43	**< .001**	0.86
		(8.55)	Dis	32	76.03	12.87	10.96	4.82	**< .001**	1.05
13	41	60.96	Adv	24	71.08	9.28	10.12	5.35	**< .001**	1.31
		(6.54)	Dis	15	71.20	14.21	10.24	2.79	**.014**	1.10
14	300	65.88	Adv	15	67.73	8.86	1.85	0.81	.431	0.16
		(11.88)	Dis	30	70.03	7.86	4.15	2.96	**.006**	0.36
15 to 19	172	66.05	Adv	15	67.20	8.99	1.15	0.50	.628	0.11
		(10.40)	Dis	33	68.58	8.93	2.53	1.63	.114	0.25
Nondominant Hand										
12	53	68.94	Adv	30	78.53	12.16	9.59	4.32	**< .001**	0.91
		(9.44)	Dis	32	84.69	10.92	15.75	8.16	**< .001**	1.56
13	41	65.61	Adv	24	78.67	8.49	13.06	7.53	**< .001**	1.42
		(9.38)	Dis	15	84.07	9.22	18.46	7.75	**< .001**	1.95
14	300	70.66	Adv	15	75.83	10.50	4.41	1.63	.126	0.52
		(8.31)	Dis	30	75.07	13.45	5.17	2.11	**.044**	0.58
15 to 19	172	70.50	Adv	15	70.80	10.63	0.30	0.11	.915	0.03
		(11.10)	Dis	33	76.61	14.56	6.11	2.41	**.022**	0.52

Note. Completion time data are presented in seconds; ESE = Hedges' *g* effect size estimate; *the sample (N = 194) included right-handed, female and male, Afrikaans- and English-speaking participants; Q Ed = Quality of Education; Adv = groups with advantaged quality of education, which included coloured and white participants; Dis = groups with disadvantaged quality of education, which included coloured participants.

As shown in Table 36, single-sample *t*-tests demonstrated a pattern of slower completion times for the younger (12- and 14-year-olds) local sample in comparison with the non-local norms for GPT1. I used the SDs from the standardization sample to evaluate whether the mean differences between local and non-local norms were clinically significant (i.e., > 1 SD), over and above being statistically significant. The differences were both statistically significant and clinically relevant, with large effect sizes (ranging from 0.86 to 1.95).

The magnitude of the difference in means between 13-year-olds from the Western Cape and those from North America for the nondominant hand, for example, was particularly large: the mean difference of 18.46 is almost 2 SDs (SD = 9.38). For the older age-group (14 to 15 years), the mean differences were statistically significant only for disadvantaged 14-year-olds (dominant and nondominant hands) and for the nondominant hand in disadvantaged 15-year-olds, and the effect sizes were moderate (0.36 to 0.52). In the aforementioned examples, the mean differences, which did not exceed one SD, were not clinically significant.

Table 37. *GPT2 Cross-Cultural Utility: Comparisons between local and non-local norms for peg removal times*

Bryden and Roy (2005) Canadian Norms				**Western Cape Norms***				**T-test Statistics**			
Age	***n***	***M***	***SD***	***Age***	***n***	***M***	***SD***	**Mean Diff**	***t***	***p***	***ESE***
Dominant Hand											
18 to 24	153	16.2	1.9	12 to 15	194	24.85	6.64	8.65	18.15	**< .001**	1.68
Nondominant Hand											
18 to 24	153	17.4	2.2	12 to 15	194	25.02	5.81	7.62	18.25	**< .001**	1.66

Note. Completion time data are presented in seconds; ESE = Hedges' *g* effect size estimate; *the sample (*N* = 194) included right-handed, 12- to 15-year-old, female and male, Afrikaans- and English-speaking, coloured and white participants, with advantaged and disadvantaged quality of education.

As the GPT peg removal task is not commonly used, there were no normative data available for adolescents. I used Bryden and Roy's (2005) original Canadian norms for young adults. Table 37 shows that the mean differences between the local sample and the Canadian sample were very large, being statistically significant, with large effect sizes, and clinically profoundly different (i.e., mean differences were 3 to 4 times larger than Bryden and Roy's SDs).

Although these findings are not completely unexpected, due to the age-differences between the samples, the magnitude of the differences is noteworthy. It would be useful to conduct a longitudinal study to see whether the extent of the mean differences decreases when the participants reach adulthood. Alternatively, it is possible that the differences in processing speed may persist, due to cultural factors other than age, for example, test-wiseness (Nell, 2000).

The GPT is a popular, quick, and user-friendly instrument that is well tolerated by participants, and endorsed by the WHO (1990) as a culture-fair instrument. However, the findings of this study demonstrate that it is essential to use local data (stratified by age and quality of education) for younger adolescents, in order to limit false-positive misdiagnoses of impaired fine motor coordination in our population.

3.1.6. Maj's Auditory Verbal Learning Test (MAVLT)

3.1.6.1. MAVLT: Relative influences of sociodemographic factors and stratified norms

Table 38 shows that only two sociodemographic variables (viz., age and quality of education) significantly predicted any outcomes on verbal memory, as measured by the various MAVLT outcome variables. Disadvantaged quality of education was associated with slightly poorer performances for Trial 5, and for Immediate and Delayed Recall trials. There were no differences in mean performances in any of the MAVLT measures between coloured and white participants with advantaged quality of education (see Table 39).

The post-hoc analyses (see Table 40) did not demonstrate any significant differences between the four age-groups. The means plots (e.g., Figure 5) also failed to demonstrate linear trends in performance. Due to the aforementioned factors, and because mean differences were all less than one integer, it was unnecessary to stratify norms for Trial 5 and Delayed Recall. Studies on the RAVLT have demonstrated similar trends to our findings in that age tends to affect verbal list-learning scores in a clustered, rather than a linear pattern. For example, Vakil et al. (1998) demonstrated clustered age-related increments between 8- to 10-year-olds and 11- to 17-year-olds for learning, forgetting, and recognition rates.

Given the data reported in Tables 38 to 40 and Figure 5, the descriptive normative data (see Table 41) were presented for the whole sample for nonparametric data (i.e. error scores) and for Trial 1, Learning Rate, Forgetting Rate, and Recognition). Norms for Trial 5, Immediate and Delayed Recall, were stratified by quality of education. Appropriately stratified normative conversion tables are available in Appendix D for Trial 1 (Table D-37), Trial 5 (Tables D-38 to D-39), Immediate Recall (Tables D-40 to D-41), Delayed Recall (Tables D-42 to D-43), Learning Rate (Table D-44), Forgetting Rate (Table D-45), and Recognition (Table D-46).

Table 38. *MAVLT Analyses of Covariance: Effects of age, sex, language, and quality of education*

	Trial 1			Trial 5		
	F	***p***	***ω²***	***F***	***p***	***ω²***
Main Effect						
Age	2.65	.105	.013	6.15	**.014**	.029
Sex	0.00	.954	.000	0.00	.990	.000
Language	0.09	.761	.000	1.25	.265	.006
Quality of Education	1.75	.187	.008	9.08	**.003**	.042
Interaction Effect						
Sex x Language	0.12	.728	.001	0.10	.757	.000
Sex x Quality of Education	0.11	.743	.001	2.24	.136	.011
Language x Quality of Ed	0.05	.830	.000	0.05	.826	.000
Sex x Language x Quality of Ed	0.28	.597	.001	0.08	.776	.000
Effect	**Learning Rate**			**Forgetting Rate**		
	F	***p***	***ω²***	***F***	***p***	***ω²***
Main Effect						
Age	0.45	.503	.002	1.25	.265	.006
Sex	0.00	.968	.000	0.35	.556	.002
Language	0.46	.501	.002	0.23	.632	.001
Quality of Education	1.91	.168	.009	0.07	.796	.000
Interaction Effect						
Sex x Language	0.31	.576	.002	0.45	.505	.002
Sex x Quality of Education	0.94	.333	.005	0.58	.448	.003
Language x Quality of Ed	0.14	.711	.001	0.00	.995	.000
Sex x Language x Quality of Ed	0.49	.487	.002	0.08	.783	.000
Effect	**Immediate Recall**			**Delayed Recall**		
	F	***p***	***ω²***	***F***	***p***	***ω²***
Main Effect						
Age	1.38	.241	.007	5.48	**.020**	.026
Sex	0.22	.638	.001	0.17	.682	.001
Language	1.69	.195	.008	0.24	.629	.001
Quality of Education	5.23	**.023**	.025	5.64	**.019**	.027
Interaction Effect						
Sex x Language	0.07	.790	.000	2.59	.109	.012
Sex x Quality of Education	3.35	.069	.016	2.14	.145	.010
Language x Quality of Ed	0.03	.860	.000	0.04	.838	.000
Sex x Language x Quality of Ed	0.00	.984	.000	0.33	.567	.002
	Recognition					
	F	***p***	***ω²***			
Main Effect						
Age	0.11	.737	.001			
Sex	0.08	.772	.000			
Language	1.90	.170	.009			
Quality of Education	2.29	.131	.011			
Interaction Effect						
Sex x Language	0.02	.897	.000			
Sex x Quality of Education	0.07	.792	.000			
Language x Quality of Ed	2.93	.088	.014			
Sex x Language x Quality of Ed	1.70	.193	.008			

Table 39. *MAVLT Analyses of Variance: Between-race comparisons for participants with advantaged quality of education*

Outcome Measure	Race						ANOVA Test Statistics	
	Coloured			White				
	n	*M*	*SD*	*n*	*M*	*SD*	*F*	*p*
Trial 1	27	6.74	1.89	67	7.21	1.76	1.30	.257
Trial 5	27	12.96	1.45	67	12.94	1.59	0.00	.949
Immediate Recall	27	11.26	1.81	67	11.97	1.98	2.61	.110
Delayed Recall	27	10.96	2.43	67	11.72	1.97	2.46	.120
Learning Rate	27	6.22	1.91	67	5.73	2.00	1.19	.279
Forgetting Rate	27	1.70	1.30	67	0.97	1.52	3.87	.059
Recognition	27	28.81	1.98	67	29.36	0.95	3.24	.075

Table 40. *MAVLT Post-hoc LSD Analyses: Mean differences for age-group comparisons*

Age (years)	Trial 5		Delayed Recall	
	Mean Difference	*p*	Mean Difference	*p*
12 vs 13	-0.37	.309	-0.25	.572
12 vs 14	-0.32	.364	-0.60	.157
12 vs 15	-0.49	.083	-0.71	.083
13 vs 14	-0.05	.893	-0.35	.449
13 vs 15	-0.22	.561	-0.46	.308
14 vs 15	-0.27	.456	-0.11	.803

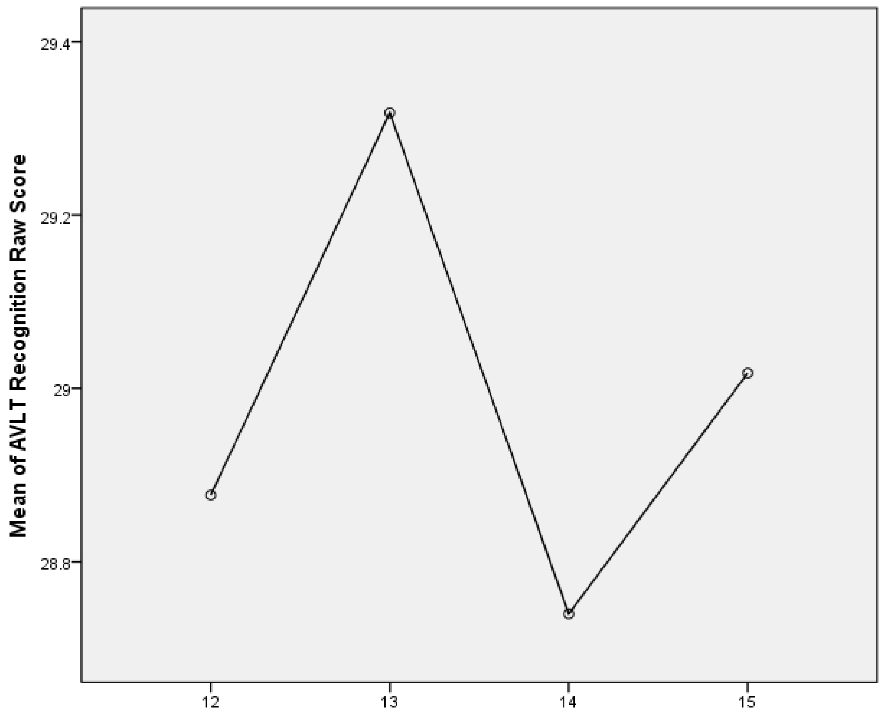

Figure 5. MAVLT means plot by age-group for Trial 5.

Table 41. *MAVLT Descriptive Normative Data: Stratified by quality of education, for Trial 5, and for the whole sample for all other outcome measures*

Outcome Measure	**Quality of Education**	***n***	**M**	**SD**	**Range**
Trial 1		215	6.87	1.82	2 - 12
Trial 5	Advantaged	94	12.95	1.54	8 - 15
	Disadvantaged	121	11.91	1.97	7 - 15
Immediate Recall	Advantaged	94	11.77	1.95	6 - 15
	Disadvantaged	121	10.70	2.31	5 - 15
Delayed Recall	Advantaged	94	11.50	2.12	5 - 15
	Disadvantaged	121	10.64	2.25	4 - 15
Learning Rate		215	5.49	2.12	0 - 11
Forgetting Rate		215	1.20	1.66	-4 - 5
Recognition		215	28.97	1.40	20 - 30
Errors: Total Repetitions		215	4.19	3.44	0 - 18
Errors: Total Insertions		215	1.35	2.03	0 - 11

Note. The whole sample (N = 215) included 12- to 15-year-old, female and male, Afrikaans and English participants; groups with advantaged quality of education included coloured and white participants; groups with disadvantaged quality of education included coloured participants; total error scores included all errors included in Trials 1 to 5; Immediate, and Delayed Recall Trials.

Our study contrasted with Anderson and Lajoie's (1996) findings of a female advantage of one word per trial for RAVLT recall trials. Otherwise, the overall performance of our sample on the MAVLT was highly consistent with trends noted in neuropsychological texts (Lezak et al., 2004; Mitrushina et al., 2005), based on overviews of multiple AVLT studies. The similarities between general trends and the findings from this study (mean ± SD in parenthesis) are summarized as follows:

1) Encoding scores (as measured by Trial 1) are typically between 6 and 7 words (6.87 ± 1.82);

2) Final acquisition scores (Trial 5) usually range from 12 to 13 (12.95 ± 1.54 for advantaged quality of education; and 11.91 ± 1.97 for disadvantaged quality of education);

3) Learning rates tend to be approximately 5 words (5.49 ± 2.12);

4) Forgetting rates typically range from 1 to 2 words (1.20 ± 1.66);

5) Short term and long term retention rates (Immediate and Delayed Recall Trials) tend to be highly similar, rarely differing by more than 2 points (mean differences = 0.27 for advantaged participants; and 0.06 for participants with disadvantaged quality of education);

6) Retrieval rates (Recognition scores) are rarely lower than 90 to 93% (96.5% ± 4.7%);

7) Error rates (Repetitions and Intrusions) rarely exceed 1 per trial, in other words, it is extremely rare to exceed a sum of 7 errors per error type, across all 5 learning trials and 2 recall trials (total repetitions = 4.19 ± 3.44; total insertions = 1.35 ± 2.03).

The implications of these findings are that the performance of our sample represents "typical" memory functioning, as measured by list-learning tasks, if a culture-fair word list (e.g., MAVLT) is employed.

3.1.6.2. MAVLT: Cross-cultural comparison of norms

Maj et al.'s (1993) normative data were published as transformed composite scores and were derived from adult samples with more than 10 years of completed education, thus unsuitable for the purposes of cross-cultural comparisons with Western Cape MAVLT norms derived from the current study. As other comparative data on the MAVLT specifically, are difficult to locate, I used Pontón et al.'s (1996) norms for USA adolescents and adults of Hispanic origin, which only published data on Trial 5, Immediate Recall, and Delayed Recall Trials.

Table 42. *MAVLT Cross-Cultural Utility: Comparisons between local and non-local norms for Trial 5, Immediate and Delayed Recall*

Ponton et al. (1996) Hispanic American Norms			**Western Cape Norms***					**T-test Statistics**		
Age	***n***	**M (SD)**	**Q Ed**	***n***	**M**	**SD**	**Mean Diff**	***t***	***p***	***ESE***
Trial 5										
16 to 29	21	13.03 (1.56)	Adv	94	12.95	1.54	-0.08	-0.52	.602	0.05
			Dis	121	11.91	1.97	-1.12	-6.26	**< .001**	0.58
Immediate Recall										
16 to 29	21	11.58 (1.73)	Adv	94	11.77	1.95	0.19	0.93	.357	0.10
			Dis	121	10.70	2.31	-0.88	-4.19	**< .001**	0.39
Delayed Recall										
16 to 29	21	11.75 (2.18)	Adv	94	11.50	2.12	-0.25	-1.14	.257	0.12
			Dis	121	10.64	2.25	-1.11	-5.40	**< .001**	0.49

Note. ESE = Hedges' *g* effect size estimate; *the sample (*N* = 215) included female and male, Afrikaans- and English-speaking participants; Q Ed = Quality of Education; Adv = groups with advantaged quality of education, which included coloured and white participants; Dis = groups with disadvantaged quality of education, which included coloured participants.

As shown in Table 42, single-sample *t*-tests comparing MAVLT performance between the advantaged group of the study sample and Pontón et al.'s (1996) older Hispanic-American sample demonstrated that on the Final acquisition trial and both recall trials, mean scores were highly compatible. For the study sample with disadvantaged quality of education, however, mean performances on all three trials were statistically significant and effect sizes were moderate. The clinical differences were not particularly meaningful, however, as all three mean differences were less than one SD in comparison with the non-local norms. The lowered performances for the disadvantaged group may be due to age differences between the samples, or due to factors specifically related to receiving poorer quality of education.

Other South African samples have demonstrated considerably lower scores in comparison with North American standardization norms on the RAVLT. For example, Jinabhai et al. (2004) showed that Zulu children with disadvantaged quality of education, from Kwa-Zulu Natal, attained total scores (i.e., the sum of trials 1 to 5) that exceeded one SD in comparison with the USA standardization norms for the RAVLT. Skuy et al. (2001) found that black-polyglot adolescents with disadvantaged quality of education, from Gauteng, recalled 10% fewer words than the USA standardization sample for the RAVLT.

The relatively better performance by this study sample may be attributable to selection of word list, racial and/or linguistic differences, or other factors. As the MAVLT holds great potential value as a relatively culture-fair instrument for assessing memory functions (particularly in comparison with the CMS Story Memory Subtest), it would be extremely useful to extend the normative database for this instrument.

It would also be extremely useful to ascertain whether the MAVLT holds up as culturally-fair for Xhosa-speaking adolescents in the Western Cape. It would be helpful for clinical and research purposes, to extend the age-, language- and racial range of this study to clarify if Maj et al.'s (1993) evidence of the cross-cultural utility of the MAVLT in other countries (e.g., Thailand, Zaire, Italy, and Germany) is true for South Africa.

3.1.7. The Rey-Osterrieth Complex Figure Test (ROCFT)

3.1.7.1. ROCFT: Relative influences of sociodemographic factors and stratified norms

Table 43. *ROCFT Analyses of Covariance: Effects of age, sex, language, and quality of education on copy completion times (in minutes), accuracy recall, and organizational measures*

	Copy Time			Copy		
	F	*p*	ω^2	*F*	*p*	ω^2
Main Effect						
Age	0.08	.778	.000	10.75	**.001**	.050
Sex	6.15	**.014**	.029	1.02	.314	.005
Language	2.95	.087	.014	0.35	.554	.002
Quality of Education	10.00	**.002**	.046	13.48	**<.001**	.061
Interaction Effect						
Sex x Language	0.18	.674	.001	0.03	.866	.000
Sex x Quality of Education	1.56	.213	.008	0.33	.569	.002
Language x Quality of Education	0.00	.955	.000	0.62	.433	.003
Sex x Language x Quality of Education	0.20	.657	.001	1.84	.176	.009
	Immediate Recall			**Delayed Recall**		
	F	*p*	ω^2	*F*	*p*	ω^2
Main Effect						
Age	13.78	**<.001**	.063	11.59	**.001**	.053
Sex	0.11	.746	.001	0.03	.856	.000
Language	0.53	.469	.003	0.16	.688	.001
Quality of Education	16.66	**<.001**	.075	15.86	**<.001**	.071
Interaction Effect						
Sex x Language	0.02	.902	.000	0.07	.788	.000
Sex x Quality of Education	0.80	.372	.004	1.34	.249	.006
Language x Quality of Education	0.16	.690	.001	0.10	.748	.001
Sex x Language x Quality of Education	3.35	.069	.016	1.62	.205	.008
	Organizational Strategy Score					
	F	*p*	ω^2			
Main Effect						
Age	7.21	**.008**	.034			
Sex	0.01	.943	.000			
Language	2.63	.106	.013			
Quality of Education	18.68	**<.001**	.083			
Interaction Effect						
Sex x Language	0.06	.807	.000			
Sex x Quality of Education	2.14	.145	.010			
Language x Quality of Education	0.25	.616	.001			
Sex x Language x Quality of Education	1.92	.167	.009			

Table 43 shows that for each ROCFT measure, there were two significant main effects. Quality of education was associated with poorer performance on all ROCFT measures, and accounted for greater percentages of variance than the other sociodemographic variables. In addition to the effects of quality of education, older age predicated superior visuospatial construction abilities (as measured by the Copy accuracy score), short and long-term retention of visual information (Immediate, and Delayed Recall accuracy scores) and the executive element of goal setting (Organizational Strategy Score). There was a significant main effect of sex for the Copy Time, indicating faster graphomotor speed for females than for males. The effects of language and interaction effects between covariates on ROCFT performance were non-significant.

Again, for reasons outlined earlier, the effects of race were investigated within the advantaged group only. Table 44 shows there were no statistically significant differences in ROCFT scores between coloured and white participants within the group with advantaged quality of education. Hence, there was no need for separate ANCOVAs including race as a covariate.

Table 44. *ROCFT Analyses of Variance: Between-race comparisons for participants with advantaged quality of education*

Outcome Measure	**Race**						**ANOVA Test Statistics**	
	Coloured			**White**				
	n	***M***	***SD***	***n***	***M***	***SD***	***F***	***p***
Copy Time	27	191.33	63.57	67	170.13	39.37	3.84	.063
Copy	27	32.41	2.40	67	32.13	2.89	0.19	.666
Immediate Recall	27	20.96	4.50	67	20.90	6.62	0.00	.966
Delayed Recall	27	19.98	4.62	67	20.51	5.96	0.17	.678
Organizational Strategy	27	5.30	0.87	67	5.15	1.02	0.43	.512

Because age was shown to be associated with performance on four of the five ROCFT outcome measures (see Table 43), it was necessary to determine how to cluster age-groups for the normative data. The results of the consequent post-hoc LSD analyses (see Table 45) and means plots (see, e.g., Figure 6) indicated stepwise linear trends, with performance increasing after the age of 12, and no differences in performances between 13-, 14-, and 15-year-olds.

The upwards step in performance on ROCFT accuracy scores (i.e., Copy, Immediate and Delayed Recall) demonstrated by our participants after the age of 12, has also been exhibited by adolescent samples from America (Meyers & Meyers, 1996) and New Zealand (Fernando et al., 2003), however the developmental step occurred a year earlier (i.e., after the age of 11) for the American standardization sample.

Table 45. *ROCFT Post-hoc LSD Analyses: Mean differences for age-group comparisons*

Age (years)	Copy		Organizational Strategy	
	Mean Difference	***p***	**Mean Difference**	***p***
12 vs 13	-2.02	**.005**	-0.56	**.005**
12 vs 14	-1.25	.070	-0.49	**.011**
12 vs 15	-1.75	**.009**	-0.50	**.007**
13 vs 14	0.77	.310	0.07	.725
13 vs 15	0.27	.715	0.06	.764
14 vs 15	-0.50	.480	-0.01	.949
Age (years)	**Immediate Recall**		**Delayed Recall**	
	Mean Difference	***p***	**Mean Difference**	***p***
12 vs 13	-1.32	.304	-2.06	.101
12 vs 14	-2.85	**.022**	-2.26	.063
12 vs 15	-3.15	**.009**	-3.25	**.006**
13 vs 14	-1.53	.259	-0.20	.883
13 vs 15	-1.83	.165	-1.19	.358
14 vs 15	0.30	.813	-0.99	.427

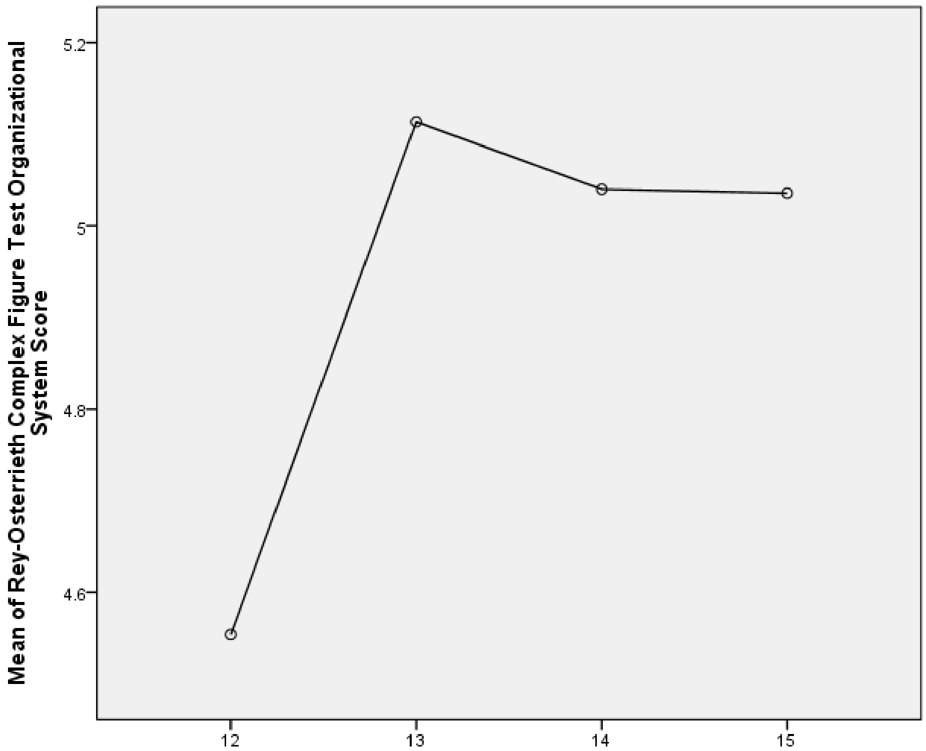

Figure 6. ROCFT means plot by age-group for organizational strategy.

Given the data reported in Tables 42 to 44 and Figure 6, as summarized above, the descriptive normative data for ROCFT Copy Time (presented in Table 45) were stratified by sex and quality of education, and stratified norm conversion tables are located in Appendix D (Tables D-47 to D-50).

Table 46. *ROCFT Descriptive Normative Data: Stratified by sex and quality of education for Copy Completion Time*

Sex	**Quality of Education**	***n***	**Mean**	**SD**	**Range**
Female	Advantaged	51	170.90	46.11	52 - 372
	Disadvantaged	66	183.33	51.25	85 - 326
Male	Advantaged	43	182.53	50.36	95 - 303
	Disadvantaged	55	223.36	100.33	87 - 600

Note. Completion time data are presented in minutes; the sample (N = 215) included 12- to 15-year-old, Afrikaans- and English-speaking participants; groups with advantaged quality of education included coloured and white participants; groups with disadvantaged quality of education included coloured participants.

The results shown in Table 46 demonstrate that the slower ROCFT copy completion times by males compared to females was larger within the groups with disadvantaged (rather than advantaged) quality of education. However, within the two groups of quality of education, sex differences were not clinically significant in relation to the quality of education SDs. Within the group with advantaged quality of education, mean differences (11.63) between males and females were approximately four times less than one SD (48.19). Within the group with disadvantaged quality of education, mean differences (40.03) between males and females were approximately half of one SD (79.71). Other studies have not demonstrated sex differences in children and adolescents for any of the ROCFT measures (Fernando et al., 2003; Meyers & Meyers, 1996). Our findings of sex differences in the ROCFT copy time are statistically unusual, but not clinically significant (as demonstrated in the preceding paragraph).

Given the data reported in Tables 43 to 45 and Figure 6, I stratified the descriptive normative data for ROCFT Copy (accuracy), Immediate Recall, Delayed Recall, and Organizational Strategy by two age-groups (12-year-olds; and 13- to 15-year-olds), and by quality of education (see Table 47). Appropriately stratified normative conversion tables are located in Appendix D for ROCFT Copy (Tables D-51 to D-54); Organizational Strategy (Tables D-55 to D-58); Immediate Recall (Tables D-59 to D-62); and Delayed Recall (Tables D-63 to D-66).

Table 47. *ROCFT Descriptive Normative Data: Stratified by age and quality of education, for Copy, Organizational Strategy, Immediate Recall, and Delayed Recall*

Outcome Measure	**Age (years)**	**Qual Ed**	***n***	**M**	**SD**	**Range**
Copy	12	Adv	31	31.15	3.18	21 - 36
		Dis	34	28.59	4.56	19 - 36
	13 to 15	Adv	63	32.74	2.37	26 - 36
		Dis	87	30.56	3.79	16 - 36
Organizational Strategy	12	Adv	31	4.71	0.78	3 - 6
		Dis	34	4.41	1.21	2 - 6
	13 to 15	Adv	63	5.43	0.98	3 - 7
		Dis	87	4.79	0.93	2 - 7
Immediate Recall	12	Adv	31	19.15	6.25	2.50 - 28.50
		Dis	34	14.87	6.30	4.00 - 25.00
	13 to 15	Adv	63	21.79	5.82	11.00 - 36.00
		Dis	87	17.61	6.48	5.50 - 34.00
Delayed Recall	12	Adv	31	19.39	5.44	7.00 - 29.00
		Dis	34	13.66	6.11	4.00 - 25.00
	13 to 15	Adv	63	20.84	5.64	9.00 - 36.00
		Dis	87	17.52	6.55	5.00 - 33.00

Note. The sample (N = 215) included female and male, Afrikaans- and English-speaking participants; groups with advantaged quality of education included coloured and white participants; groups with disadvantaged quality of education included coloured participants.

The data in Table 47 show that for all itemized measures, poorer ROCFT performance was associated with younger age and disadvantaged quality of education. However, within each type of quality of education, the age-related differences were not clinically significant for any of the subgroups. Within the groups with advantaged quality of education, mean differences in performances between the two age-groups were all less than one SD (Copy mean difference = 1.59; < SD = 2.75; Organizational Strategy mean difference = 0.72; < SD = 0.98; Immediate Recall mean difference = 2.64; < SD = 6.06; and Delayed Recall mean difference = 1.45; < SD = 5.59). Within the groups with disadvantaged quality of education, mean differences between the 12-year-olds and 13- to 15-year-olds also did not exceed one SD (Copy mean difference = 1.97; < SD = 4.10; Organizational Strategy mean difference = 0.38; < SD = 1.03; Immediate Recall mean difference = 2.74; < SD = 6.52; and Delayed Recall mean difference = 3.86; < SD = 6.65). The results described above indicate that the subtle and clinically non-significant age-related differences in performances in ROCFT measures seem to be mediated by quality of education.

3.1.7.2. ROCFT: Cross-cultural comparison of norms

In order to investigate the cross-cultural utility of the Western Cape ROCFT norms derived from the current data, I compared those data with the standardization norms published in Meyers and Meyers' (1996) test manual. For this comparison, I used the four age-group divisions that were used in the manual, and I stratified each age-group by sex and quality of education for the Copy Time measure (see Table 48) and by quality of education for the accuracy scores for the Copy (Table 49), Immediate and Delayed Recall (Table 50) measures.

Table 48. *ROCFT Cross-Cultural Utility: Comparisons between local and non-local norms for Copy Completion Times*

Meyers & Meyers (1996) USA Standardization Norms			**Western Cape Norms***					**T-test Statistics**			
Age	***n***	**M (SD)**	**Sex**	**Q Ed**	***n***	**M**	**SD**	**Mean Diff**	***t***	***p***	***ESE***
12	44	317.58 (106.91)	Fem	Adv	18	189.11	29.06	-128.47	-18.75	**< .001**	1.38
				Dis	19	196.79	53.07	-120.79	-9.92	**< .001**	1.27
			Male	Adv	13	202.92	43.70	-114.66	-9.46	**< .001**	1.17
				Dis	15	201.60	43.35	-115.98	-10.36	**< .001**	1.20
13	48	305.93 (101.60)	Fem	Adv	12	153.00	15.27	-152.93	-34.70	**< .001**	1.65
				Dis	12	200.17	60.52	-105.76	-6.05	**< .001**	1.10
			Male	Adv	14	171.14	56.37	-134.79	-8.95	**< .001**	1.42
				Dis	6	280.50	181.58	-25.43	-0.34	.746	0.22
14	32	296.39 (96.26)	Fem	Adv	8	145.00	44.75	-151.39	-9.57	**< .001**	1.67
				Dis	17	167.65	43.17	-128.74	-12.30	**< .001**	1.54
			Male	Adv	10	175.50	50.23	-120.89	-7.61	**< .001**	1.35
				Dis	15	193.07	76.06	-103.32	-5.26	**< .001**	1.12
15	43	288.97 (90.87)	Fem	Adv	13	178.15	70.42	-110.82	-5.67	**< .001**	1.26
				Dis	18	172.72	46.57	-116.25	-10.59	**< .001**	1.42
			Male	Adv	6	176.67	48.31	-112.30	-5.70	**.002**	1.27
				Dis	19	246.42	110.77	-42.55	-1.67	.111	0.43

Note. Completion time data are presented in minutes; ESE = Hedges' *g* effect size estimate; *the sample (N = 215) included female and male, Afrikaans- and English-speaking participants; Q Ed = Quality of Education; Adv = subgroups with advantaged quality of education, which included coloured and white participants; Dis = subgroups with disadvantaged quality of education, which included coloured participants.

As shown in Table 48, single-sample *t*-tests demonstrated that the Western Cape sample completed the ROCT copy faster than the American standardization sample. Mean differences between the local and non-local norms were statistically and clinically significant (i.e. > 1 SD of the non-local norms), and effect sizes were large, except for 13-year-old and 15-year-old males with disadvantaged quality of education (for whom the mean differences were non-significant). This finding is at odds with the other findings in this dissertation with regard to timed measures, where the local sample performed considerably slower than non-local samples (e.g., for CCTT and GPT completion times).

Although Meyers and Meyers (1996) demonstrated that the ROCFT Time is highly loaded on the factor of graphomotor speed, other authors have tended not to focus on this particular outcome measure (Lezak et al., 2004; Strauss et al., 2006). Although the reasons for de-emphasizing the Copy completion time in relation to the accuracy scores have not been explicitly articulated, it is possible that the latter measure has limited usefulness. It is unlikely, given the other speed-related findings in this study, that faster ROCFT copy time indicates superior performance. Faster speed in this particular measure may be attributable to other factors (e.g., carelessness or insufficient attention to detail) and may, in fact, be associated with the relatively poorer performances on accuracy scores within the local sample with disadvantaged quality of education (see discussion below). However, this speculative and tentative hypothesis would need to be verified empirically.

Table 49. *ROCFT Cross-Cultural Utility: Comparisons between local and non-local norms for Copy accuracy scores*

Meyers & Meyers (1996) USA Standardization Norms			**Western Cape Norms***				**T-test Statistics**			
Age	***n***	**M (SD)**	**Q Ed**	***n***	**M**	**SD**	**Mean Diff**	***t***	***p***	***ESE***
12	44	34.06 (2.60)	Adv	31	31.15	3.18	-2.91	-5.11	**< .001**	1.01
			Dis	34	28.59	4.56	-5.47	-7.00	**< .001**	1.51
13	48	33.78 (2.34)	Adv	26	32.98	1.95	-0.80	-2.09	**.047**	0.36
			Dis	18	30.17	2.89	-3.61	-5.30	**< .001**	1.43
14	32	33.44 (2.22)	Adv	18	32.28	2.91	-1.16	-1.69	.110	0-.59
			Dis	32	10.38	3.55	-3.07	-4.89	**< .001**	1.17
15	43	33.39 (2.23)	Adv	19	32.84	2.39	-0.55	-1.00	.330	0.39
			Dis	37	30.92	4.38	-2.47	-3.43	**.002**	0.84

Note. ESE = Hedges' *g* effect size estimate; *the sample (*N* = 215) included female and male, Afrikaans- and English-speaking participants; Q Ed = Quality of Education; Adv = subgroups with advantaged quality of education, which included coloured and white participants; Dis = subgroups with disadvantaged quality of education, which included coloured participants.

The results of the t-test comparisons shown in Table 48 indicate that visuospatial abilities, as measured by the ROCFT copy accuracy score, were poorer for local 12-year-olds, and for participants with disadvantaged quality of education, in comparison with the USA standardization norms. The mean differences between local and non-local scores were more pronounced within groups with disadvantaged (compared to advantaged) quality of education. Within the advantaged groups, although mean differences between local and non-local scores exceeded one SD for the 12-year-olds, statistical differences were not clinically meaningful for 13-year-olds (< 1 SD), and non-significant for 14-year-olds and 15-year-olds. In contrast, within the disadvantaged groups, all mean differences between local and non-local norms were statistically and clinically significant (> 1 SD), particularly for 12-year-olds (> 2 SD).

The implications of these findings are that for participants matching the demographic profile of my study, although non-local norms for the ROCFT copy accuracy score are acceptable for 13- to 15-year-old advantaged participants, it is essential to use local normative data stratified by age-group and by quality of education for disadvantaged participants. The failure to use adequately stratified norms for the latter population profile may increase the risk of false-positive misdiagnoses of visuospatial deficits.

Table 50 shows a pervasive pattern of lowered retention scores by the local sample in comparison with the American norms. However, within the groups with advantaged quality of education, estimated effect sizes are small to moderate, and none of the statistically significant differences exceed one SD, and thus are clinically not noteworthy. Within the groups with disadvantaged education, the mean differences between local and non-local norms have large effect sizes and are both statistically and clinically significant (>1 SD).

The lowered scores for disadvantaged participants is consistent with Skuy et al.'s (2001) findings of similar differences between black disadvantaged adolescents from Gauteng in comparison with norms from the USA. Skuy and colleagues demonstrated mean differences exceeding one SD on the copy accuracy score, and differences of one to two SDs for a single recall trial (after a 30 minute delay). The lowered visual memory scores for the South African studies may be related to test-wiseness (C. D. Foxcroft, 2004; Nell, 2000). It is possible that the incidental learning nature of the task may contribute to lowered scores: participants with more psychometric test experience may be alerted to the possibility of unprepared recall tasks, thus may actively memorize material during the copy trial. It would be useful to investigate the difference in visual memory performance between the ROCFT recall trials and other cognitive measures that specifically instruct participants to remember the visual information, for example, the CMS Dot Locations Subtest (Cohen, 1997).

Our findings were consistent with other literature on ROCFT as a measure of visual memory, indicating that Immediate and Delayed Recall scores rarely decline by more than 2 points in participants without visuospatial deficits (Berry et al., 1991; Heinrichs & Bury, 1991). This suggests that it is unlikely that the lowered memory scores attained by the local participants are indicative of abnormal visual memory, and are more likely to be associated with cultural factors. My findings indicate that Meyers and Meyers' (1996) USA standardization norms may be appropriate for participants with advantaged quality of education, but not for disadvantaged participants. For the latter population, to guard against false-positive diagnoses of deficits in short-term and long-term retention of visual information, I would advise using stratified local norms.

Table 50. *ROCFT Cross-Cultural Utility: Comparisons between local and non-local norms for Immediate and Delayed Recall accuracy scores*

Meyers & Meyers (1996) USA Standardization Norms			Western Cape Norms*				T-test Statistics			
Age	***n***	**M (SD)**	**Q Ed**	***n***	**M**	**SD**	**Mean Diff**	***t***	***p***	***ESE***
Immediate Recall										
12	44	22.61 (5.48)	Adv	31	19.15	6.25	-3.46	-3.08	**.004**	0.59
			Dis	34	14.87	6.30	-7.74	-7.17	**< .001**	1.31
13	48	23.06 (5.44)	Adv	26	19.90	5.25	-3.16	-3.06	**.005**	0.58
			Dis	18	15.81	4.67	-7.25	-6.58	**< .001**	1.37
14	32	23.38 (5.38)	Adv	18	23.42	7.06	0.04	0.02	.983	0.00
			Dis	32	17.70	6.26	-5.68	-5.13	**< .001**	0.97
15	43	23.74 (5.29)	Adv	19	22.84	4.72	-0.90	-0.83	.418	0.18
			Dis	37	18.42	7.35	-5.32	-4.40	**< .001**	0.78
Delayed Recall										
12	44	22.46 (5.32)	Adv	31	19.39	5.44	-3.07	-3.14	**.004**	0.57
			Dis	34	13.66	6.11	-8.80	-8.40	**< .001**	1.53
13	48	22.89 (5.19)	Adv	26	19.37	5.41	-3.53	-3.32	.003	0.66
			Dis	18	17.14	5.54	-5.75	-4.41	**< .001**	1.08
14	32	23.26 (5.09)	Adv	18	22.61	6.36	-0.65	-0.43	.670	0.11
			Dis	32	16.42	5.91	-6.84	-6.54	**< .001**	1.23
15	43	23.77 (5.05)	Adv	19	21.18	4.91	-2.59	-2.29	.034	0.51
			Dis	37	18.65	7.44	-5.12	-4.19	**< .001**	0.81

Note. ESE = Hedges' *g* effect size estimate; *the sample (*N* = 215) included female and male, Afrikaans- and English-speaking participants; Q Ed = Quality of Education; Adv = subgroups with advantaged quality of education, which included coloured and white participants; Dis = subgroups with disadvantaged quality of education, which included coloured participants.

To evaluate the cross-cultural utility of norms for the ROCFT Organizational Strategy, as a measure of executive functioning (planning and organization in particular), I compared our norms with Anderson et al.'s (2001) standardization data derived from Australian 12- to 13-year-olds (see Table 51). The results of the t-tests indicated higher scores (both statistically and clinically significant) for 12- and 13-year-olds from the Western Cape sample, in comparison with the Australian sample. The implications of the findings are that the non-local norms may underestimate the local participants' ability to organize visual material configurally (rather than in a fragmented fashion).

Table 51. *ROCFT Cross-Cultural Utility: Comparisons between local and non-local norms for Organizational Strategy scores*

Anderson et al. (2001) Australian Norms			**Western Cape Norms***				**T-test Statistics**			
Age	***n***	**M (SD)**	**Q Ed**	***n***	**M**	**SD**	**Mean Diff**	***t***	***p***	***ESE***
12	54	3.3 (1.0)	Adv	31	4.71	0.78	1.41	10.03	**< .001**	1.51
			Dis	34	4.41	1.21	1.11	5.36	**< .001**	1.01
13	51	3.5 (0.9)	Adv	26	5.31	0.88	1.81	10.43	**< .001**	1.40
			Dis	18	4.83	0.71	1.33	8.00	**< .001**	1.54

Note. ESE = Hedges' *g* effect size estimate; *the sample (*N* = 215) included female and male, Afrikaans- and English-speaking participants; Q Ed = Quality of Education; Adv = subgroups with advantaged quality of education, which included coloured and white participants; Dis = subgroups with disadvantaged quality of education, which included coloured participants.

In summary, the overall findings regarding the ROCFT for participants matching the sociodemographic profile of the study population are as follows: 1) it is questionable whether the Copy Time is a useful measure of graphomotor speed; 2) for participants with disadvantaged quality of education, the utility of the ROCFT Copy accuracy score as a measure of visuospatial functioning, and the ROCFT Recall accuracy scores as measures of incidental recall of visual material, is contingent on the use of appropriately stratified local norms; 3) the use of the norms published in Meyers and Meyers (1996) manual are suitable for 12- to 15-year-old, Afrikaans- and English-speaking, male and female, coloured and white participants with advantaged quality of education; and 4) Anderson et al.'s (2001) normative data do not accurately characterize the planning/organizational abilities for the Western Cape sample.

3.1.8. Stroop Color-Word Test (SCWT)

3.1.8.1. SCWT: Relative influences of sociodemographic factors and stratified norms

The results of the analyses of variance to determine the relative impact of sociodemographic variables on Golden et al.'s (2003) version of the SCWT demonstrated that younger age and disadvantaged quality of education were associated with poorer performance on all three outcome variables (see Table 52). The other main effects of sex and language, and all interaction effects were non-significant.

Table 52. *SCWT Analyses of Covariance: Effects of age, sex, language, and quality of education*

	Word Page			Color Page		
	F	***p***	ω^2	***F***	***p***	ω^2
Main Effect						
Age	23.63	**<.001**	.103	25.77	**<.001**	.111
Sex	2.76	.098	.013	2.95	.087	.014
Language	0.03	.858	.000	0.67	.413	.003
Quality of Education	33.48	**<.001**	.140	29.78	**<.001**	.126
Interaction Effect						
Sex x Language	0.11	.742	.001	0.21	.647	.001
Sex x Quality of Education	1.02	.315	.005	0.31	.577	.002
Language x Quality of Education	0.11	.738	.001	1.04	.308	.005
Sex x Language x Quality of Ed	0.05	.817	.000	0.28	.597	.001

	Color-Word Page		
	F	***p***	ω^2
Main Effect			
Age	25.97	**<.001**	.112
Sex	0.09	.764	.000
Language	3.53	.062	.017
Quality of Education	43.47	**<.001**	.174
Interaction Effect			
Sex x Language	0.43	.515	.002
Sex x Quality of Education	0.15	.704	.001
Language x Quality of Education	4.57	.054	.023
Sex x Language x Quality of Ed	1.52	.219	.007

The Word page (as a measure of reading speed), and the Color page (as an indication of the ability to distinguish three colours), are preliminary tasks to the Color-Word page, which measures response inhibition (i.e., a specific subcategory of cognitive flexibility). The Word page and the Color page are not generally regarded as measures of executive functioning, but are useful to rule out the possibility of reading speed and difficulties with colour differentiation as potential confounds when interpreting performance on the Color-Word page (Lezak et al., 2004; MacLeod, 1991; Strauss et al., 2006). For all three outcome measures, age contributed to a large portion of the variance (10.3 to 11.2%), but the magnitude of the effect of quality of education was even larger (14.0% for the Word page, 12.6% for the Color page, and 17.4% for the Color-Word page.

Once again, for reasons outlined earlier, the effects of race were investigated within the advantaged group only. Table 53 shows that there were no statistically significant differences in SCWT scores between coloured and white participants within the group with advantaged quality of education, obviating the need for separate ANCOVAs including race as a covariate.

Table 53. *SCWT Analyses of Variance: Between-race comparisons for participants with advantaged quality of education*

Outcome Measure	**Race**						**ANOVA Test Statistics**	
	Coloured			**White**				
	n	***M***	***SD***	***n***	***M***	***SD***	***F***	***p***
Word Page	27	85.19	14.04	67	88.13	14.31	0.83	.366
Color Page	27	60.00	9.71	67	64.51	11.85	3.07	.083
Color-Word Page	27	35.22	7.48	67	39.76	11.21	3.74	.056

Due to the strong relationships between age and SCWT scores (see Table 51), further investigation was necessary to determine how to cluster age-groups for the norms. The results of the consequent post-hoc LSD analyses (see Table 54) and means plots for the Word task, and the Color task, demonstrated two developmental steps after the age of 12, and again after the age of 14, necessitating three subgroups for norm stratification (viz., 12 years; 13 to 14 years; and 15 years). Table 54 and Figure 7 indicate a gradual linear developmental incline for the Color-Word page, necessitating subdivision of norms into four age-groups for this measure.

Table 54. *SCWT Post-hoc LSD Analyses: Mean differences for age-group comparisons*

Age (years)	**Word Page**		**Color Page**		**Color-Word Page**	
	Mean Difference	***p***	**Mean Difference**	***p***	**Mean Difference**	***P***
12 vs 13	-4.85	.092	-3.14	.150	-1.98	.286
12 vs 14	-4.84	.080	-3.06	.146	-4.36	**.016**
12 vs 15	-10.55	**<.001**	-9.01	**<.001**	-6.68	**<.001**
13 vs 14	0.00	.999	0.08	.973	-2.37	.229
13 vs 15	-5.71	.054	-5.87	**.009**	-4.70	**.015**
14 vs 15	-5.71	**.046**	-5.95	**.006**	-2.32	.209

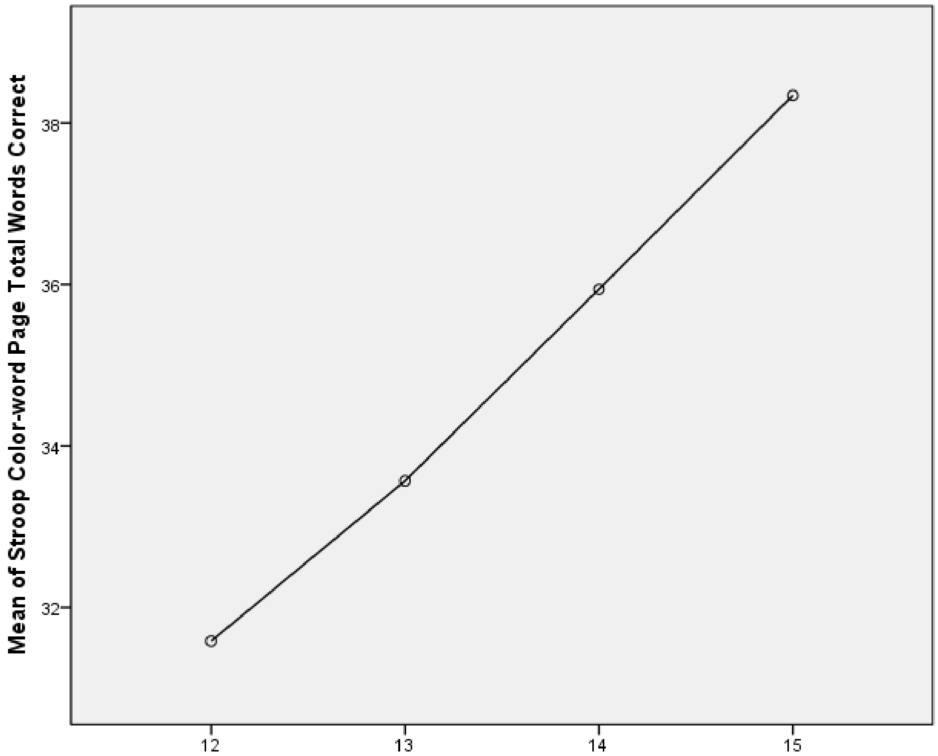

Figure 7. SCWT means plot by age-group for the Color-Word task.

Given the data summarized above, the descriptive normative data (see Table 55) were stratified by quality of education and three age-groups (12 years; 13 to 14 years; and 15 years) for the Color, and Word tasks, and by quality of education and four age-groups (12, 13, 14, and 15 years) for the Color-Word task. I present equivalently stratified normative conversion tables in Appendix D for the Word task (Tables D-67 to D-72), the Color task (Tables D-73 to D-78), and the Color-Word task (Tables D-79 to D-86).

The overall findings shown in Table 55 demonstrate gradual increments in performance from younger to older age-groups, for participants with advantaged and disadvantaged quality of education. The stepwise improvements across each age-group are slightly lower than one SD, but provide clinically meaningful information with regards to the gradual developmental trajectory. Similar trends of linear improvements were exhibited in Golden et al.'s (2003) standardization sample, but performances tended to stabilize at a younger age in comparison with our study. Our studies were also consistent with Golden et al.'s (2003) regarding the absence of sex differences for all three tasks of the SCWT.

Table 55. *SCWT Descriptive Normative Data: Stratified by age and quality of education*

Age (years)	Quality of Education	*n*	*M*	*SD*	Range
Word Page					
12	Advantaged	31	82.23	10.90	60 - 112
	Disadvantaged	34	69.71	11.28	45 - 93
13 to 14	Advantaged	44	86.91	14.51	53 - 115
	Disadvantaged	51	74.96	12.88	39 - 100
15	Advantaged	19	96.42	14.54	72 - 121
	Disadvantaged	36	80.89	14.72	44 - 108
Color Page					
12	Advantaged	31	59.68	10.16	39 - 91
	Disadvantaged	34	51.38	8.59	36 - 77
13 to 14	Advantaged	44	62.43	11.01	39 - 90
	Disadvantaged	51	54.92	8.29	39 - 75
15	Advantaged	19	70.79	11.30	53 - 85
	Disadvantaged	36	61.08	13.22	34 - 99
Color-Word Page					
12	Advantaged	31	35.06	9.51	20 - 58
	Disadvantaged	34	28.41	6.24	16 - 40
13	Advantaged	26	37.35	9.01	17 - 52
	Disadvantaged	18	28.71	7.72	10 - 40
14	Advantaged	18	40.44	12.89	25 - 72
	Disadvantaged	32	33.41	7.82	17 - 48
15	Advantaged	19	43.63	9.48	24 - 62
	Disadvantaged	37	35.62	8.76	18 - 54

Note. The sample (N = 215) included female and male, Afrikaans- and English-speaking participants; groups with advantaged quality of education included coloured and white participants; groups with disadvantaged quality of education included coloured participants.

The overall implications of the findings shown in Table 55 are that for the sociodemographic profile of the study population, it is essential to use normative data that are stratified by quality of education. Furthermore, the additional stratification by age is clinically informative due to the gradual improvement in performance with increasing age. Our findings suggest that norms that are stratified by both age and quality of education are likely to provide reliable indications of developmentally-appropriate word-reading speed, colour differentiation, and cognitive flexibility.

3.1.8.2. SCWT: Cross-cultural comparison of norms

In order to investigate the cross-cultural utility of the Western Cape SCWT norms derived from the current data, I compared those data with the norms published in Golden et al.'s (2003) manual for 5- to 14-year-olds. For this comparison, I used the two age-group divisions that were used in the manual, and I stratified each age-group by quality of education.

Golden and Freshwater's (2002) norms for 15-year-olds are provided in a different format from the manual for 5- to-14-year-olds. Because they are cited as predicted scores, rather than raw scores, and because no means, SDs or sample sizes are provided, it is impossible to conduct t-tests or to calculate effect sizes. Due to the age-related increments in performance shown in our sample, the norms for 13- to 14-year-olds would probably have underestimated performance in the 15-year-olds. Consequently, I only performed t-test comparisons for 12- to 14-year-olds.

Table 56. *SCWT Cross-Cultural Utility: Comparisons between local and non-local norms*

Golden et al.'s (2003) USA Standardization Norms			**Western Cape Norms***				**T-test Statistics**			
Age	***n***	**M (SD)**	**Q Ed**	***n***	**M**	**SD**	**Mean Diff**	***t***	***p***	***ESE***
Word Page										
11 to 12	25	70.82 (18.81)	Adv	31	82.23	10.90	11.41	5.83	**<.001**	0.75
			Dis	34	69.71	11.28	-1.11	-0.58	.569	0.07
13 to 14	23	74.76 (19.04)	Adv	44	86.91	14.51	12.15	5.57	**<.001**	0.75
			Dis	51	74.96	12.88	0.20	0.11	.912	0.01
Color Page										
11 to 12	25	61.00 (15.61)	Adv	31	59.68	10.16	-1.32	-0.73	.474	0.10
			Dis	34	51.38	8.59	-9.62	-6.53	**<.001**	0.79
13 to 14	23	65.12 (16.91)	Adv	44	62.43	11.01	-2.69	-1.62	.113	0.20
			Dis	51	54.92	8.29	-10.20	-8.78	**<.001**	0.87
Color-Word Page										
11 to 12	25	38.20 (8.39)	Adv	31	35.06	9.51	-3.14	-1.84	.076	0.34
			Dis	34	28.41	6.24	-9.79	-9.15	**<.001**	1.34
13 to 14	23	40.30 (9.01)	Adv	44	38.61	10.73	-1.69	-1.04	.303	0.17
			Dis	51	31.49	8.04	-8.81	-7.82	**< .001**	1.09

Note. ESE = Hedges' *g* effect size estimate; *the sample (*N* = 160) included female and male, Afrikaans- and English-speaking participants; Q Ed = Quality of Education; Adv = groups with advantaged quality of education, which included coloured and white participants; Dis = groups with disadvantaged quality of education, which included coloured participants.

The results of the single-sample *t*-tests (see Table 56) showed that for participants with advantaged quality of education, the local sample accurately read more words within the 45-second limit, in comparison with the American sample. Although the differences were statistically significant, with large effect sizes, they were not clinically significant (< 1 SD), in comparison to the SDs for the non-local sample. Word page scores between the local disadvantaged group and the American sample were equivalent.

For the Color page, local and non-local norms did not differ significantly in the groups with advantaged quality of education. Although mean differences between the two sets of norms within the groups with disadvantaged education were statistically significant with large effect sizes, they were clinically non-significant (< 1 SD).

Performance on the Color-Word page between the two sets of norms was similar for the advantaged participants. However, for the disadvantaged group, scores were clinically and statistically significant (> 1 SD), and effect sizes were large.

These findings are consistent with Skuy et al.'s (2001) study that demonstrated lowered executive abilities between black-polyglot adolescents with disadvantaged quality of education from Gauteng, in comparison with non-local American norms. The cross-cultural comparisons indicate that for local participants with disadvantaged quality of education, the use of Golden et al.'s (2003) norms are not recommended, due to the enhanced risk of false positive misdiagnoses of impaired cognitive flexibility. For participants with advantaged quality of education, however, the use of Golden et al.'s norms would be unlikely to result in interpretive errors.

3.1.9. Tower of London (ToL)

3.1.9.1. ToL: Relative influences of sociodemographic factors and stratified norms

Data for two of the outcome measures (viz., Total Correct, and Total Time) for Culbertson and Zillmer's (2001) ToL were normally distributed. Table 56 shows that neither of the sociodemographic effects measured was associated with outcome on executive planning ability (as measured by the Total Correct score). Younger age was associated with slower Total Time needed to complete all 10 ToL tasks (which measures efficiency of problem-solving time, or information processing speed).

Table 57. *ToL Analyses of Covariance: Effects of age, sex, language, and quality of education on Total Correct and Total Time*

	Total Correct			Total Time		
	F	***p***	ω^2	***F***	***p***	ω^2
Main Effect						
Age	2.75	.099	.013	5.83	**.017**	.028
Sex	0.15	.703	.001	0.09	.764	.000
Language	1.13	.290	.005	1.86	.174	.009
Quality of Education	2.37	.125	.011	2.77	.097	.013
Interaction Effect						
Sex x Language	0.66	.419	.003	0.16	.693	.001
Sex x Quality of Education	0.49	.486	.002	1.15	.285	.006
Language x Quality of Education	2.05	.154	.010	0.00	.977	.000
Sex x Language x Quality of Education	0.40	.529	.002	0.03	.858	.000

Again, for reasons outlined earlier, the effects of race were investigated within the advantaged group only. Table 58 shows that there were no statistically significant differences in Total Correct of Total Time scores between coloured and white participants within the group with advantaged quality of education. Hence, there was no need for separate ANCOVAs including race as a covariate.

Table 58. *ToL Analyses of Variance: Between-race comparisons for participants with advantaged quality of education on Total Correct and Total Time*

Outcome Measure	**Race**						**ANOVA Test Statistics**	
	Coloured			**White**				
	n	***M***	***SD***	***n***	***M***	***SD***	***F***	***p***
Total Correct	27	3.41	1.58	67	3.76	1.72	0.85	.359
Total Time	27	207.70	63.26	67	209.76	74.99	0.02	.900

Note. Data for Total Correct are presented in raw scores; data for Total Time are presented in seconds.

Because age was not shown to be associated with performance on the Total Correct measure, normative data were presented for the combined group of 12- to 15-year-olds. Because age was shown to be associated with performance on Total Time (see Table 57), it was necessary to determine how to cluster age-groups for the normative data. The results of the consequent post-hoc LSD analyses (see Table 59) and means plots (see, e.g., Figure 8) demonstrated that there were statistically significant age-related differences in performance between 12-year-olds and the other age groups, indicating a developmental step in problem-solving efficiency after the age of 12.

Table 59. *ToL Post-hoc LSD Analyses: Mean differences for age-group comparisons on Total Time*

	Mean Difference	*p*
12 vs 13	51.16	**.001**
12 vs 14	36.84	**.009**
12 vs 15	32.56	**.017**
13 vs 14	-14.33	.353
13 vs 15	-18.61	.214
14 vs 15	-4.28	.767

Note. Completion time data are presented in seconds.

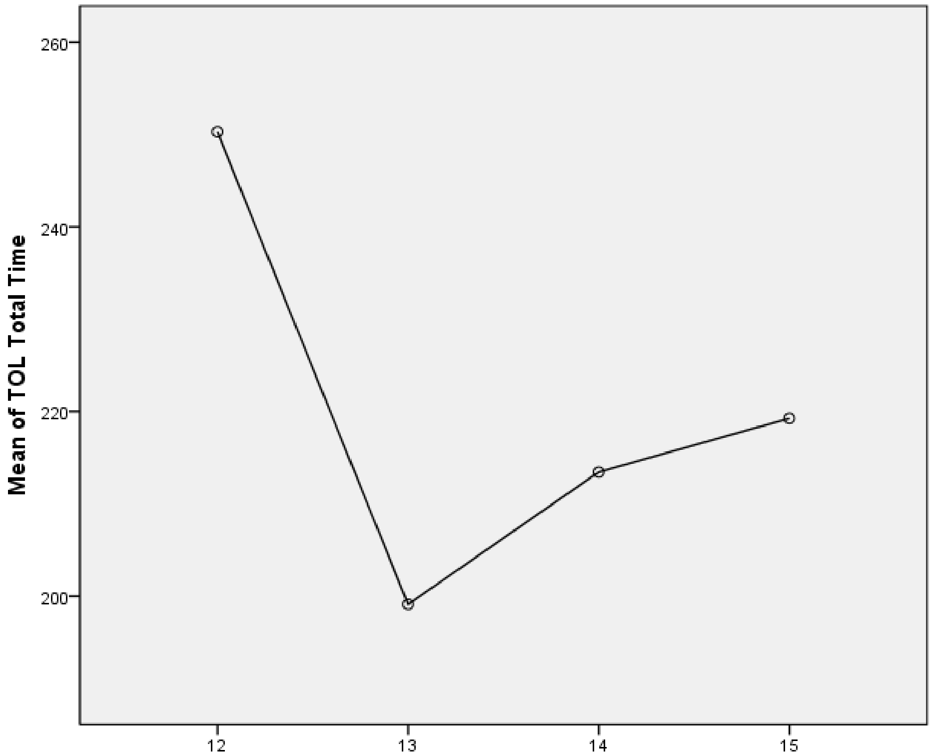

Figure 8. ToL means plot by age-group for Total Time (in seconds).

In accordance with the abovementioned results, descriptive normative data (see Table 60) were presented for the whole sample for ToL Total Correct, and stratified in two age-groups (12-year-olds, and 13- to 15-year-olds) for ToL Total Time. Normative conversion tables are located in Appendix D for Total Correct (Table D-87) and Total Time (Tables D-88 to D-89). I also presented descriptive norms for these measures for the whole sample in Table 60.

The mean difference (38.87 seconds) between 12-year-olds and 13- to 15-year-olds on ToL completion time was statistically, but not clinically significant (< 1 SD). Our findings, that demonstrated consistency between the ages of 12 and 15, differed slightly from previous findings of subtle increments in ToL performance with advancing age in adolescence (P. Anderson et al., 1996; Krikorian et al., 1994). Our findings are consistent with other studies that show that sex does not appear to influence performance on the ToL in adolescents (P. Anderson et al., 1996; Culbertson & Zillmer, 2001).

Table 60. *ToL Descriptive Normative Data: Stratified by age for Total Time, and presented for the whole sample for Total Correct, Time Violations, and Rule Violations*

Outcome Measure	**Age (years)**	***n***	***M***	***SD***	**Range**
Total Time	12	65	250.28	87.21	116 - 494
	13 to 15	150	211.41	68.01	92 - 438
Total Correct	12 to 15	215	3.59	1.60	0 - 9
Total Rule Violations	12 to 15	215	0.19	0.86	0 - 8
Total Time Violations	12 to 15	215	0.45	0.75	0 - 4

Note. Completion time data are presented in seconds; Total Correct data are presented in raw scores; the sample (N = 215) included female and male, Afrikaans- and English-speaking participants, coloured and white participants with advantaged and disadvantaged quality of education.

3.1.9.2. ToL: Cross-cultural comparison of norms

In order to investigate the cross-cultural utility of the Western Cape ToL norms derived from the current data, I compared those data with the USA standardization norms published in Culbertson and Zillmer's (2001) test manual (see Table 61). For this comparison, I used the age-group divisions that were used in the manual.

I used the SDs from the standardization sample to evaluate whether the mean differences between local and non-local norms were clinically significant (i.e., > 1 SD), over and above being statistically significant. Table 61, which presents the findings of the t-test comparisons, shows that the mean differences between the local and non-local norms were statistically significant for most variables, with moderate effect sizes, but none of the scores differed by more than one SD. The findings imply that the differences between the two sets of norms are not clinically significant.

The implications of the aforementioned results are that the ToL seems to be a culture-fair measure, within the local population, and between the local and American samples, and that the norms in the Culberson and Zillmer's (2001) test manual are appropriate for participants meeting the sociodemographic profile of this study. Site observations by the testers confirmed the ToL's reputation as a test that was particularly well liked by adolescents. Previous literature has demonstrated the clinical utility of the ToL in identifying executive planning disorders (e.g., Cornoldi et al., 1999; Hughes et al., 1994; Lezak et al., 2004; Sikora et al., 2002). It would be useful to confirm the ToL's reputed utility for clinical samples in the local population in future studies.

Table 61. *ToL Cross-Cultural Utility: Comparisons between local and non-local norms*

Culbertson & Zillmer's (2001) USA Standardization Norms				**Western Cape Norms***				**T-test Statistics**			
Age	***n***	***M***	***SD***	**Age**	***n***	***M***	***SD***	**Mean Diff**	***t***	***p***	***ESE***
Total Correct											
11 - 12	103	4.2	1.8	12	65	3.45	1.51	-0.75	-4.02	**<.001**	0.44
13 - 15	76	4.4	1.7	13 - 15	150	3.65	1.64	-5.64	-5.64	**<.001**	0.45
Total Time											
11 - 12	103	196.9	88.2	12	65	250.28	87.21	53.38	4.93	**<.001**	0.60
13 - 15	76	168.3	56.6	13 - 15	150	211.41	68.00	43.11	7.76	**<.001**	0.67
Total Time Violations											
11 - 12	103	0.6	0.9	12	65	0.78	0.98	0.19	1.53	.132	0.19
13 - 15	76	0.1	0.5	13 - 15	150	0.31	0.57	0.21	4.46	**<.001**	0.38
Total Rule Violations											
11 - 12	103	0.6	1.1	12	65	0.15	0.89	-0.45	-4.05	**<.001**	0.44
13 - 15	76	0.1	0.3	13 - 15	150	0.21	0.85	0.11	1.55	.125	0.37

Note. Completion time data are presented in seconds; ESE = Hedges' *g* effect size estimate; *the sample (N = 215) included female and male, Afrikaans- and English-speaking, coloured and white participants, with advantaged and disadvantaged quality of education.

3.1.10. Verbal Fluency Tests

3.1.10.1. Phonemic Fluency

3.1.10.1.1. Phonemic Fluency: Relative influences of sociodemographic factors and stratified norms

I used the total number of words generated for the three letters (L, B, and S) as a measure of executive functioning (specifically, set-shifting, which is an aspect of cognitive flexibility). Phonemic Fluency scores were associated with age, which accounted for the largest portion of variance (9.7%), quality of education (6.7%) and language (2.4%). Poorer performance was predicted by younger age, disadvantaged quality of education, and Afrikaans language. The impact of sex and the interaction effects of the covariates on verbal generativity were not significant.

Table 62. *Phonemic Fluency Analyses of Covariance: Effects of age, sex, language, and quality of education on total words generated for letters L, B, and S*

	F	*p*	ω^2
Main Effect			
Age	29.68	**<.001**	.097
Sex	1.04	.309	.004
Language	6.79	**.010**	.024
Quality of Education	19.85	**<.001**	.067
Interaction Effect			
Sex x Language	0.11	.744	.000
Sex x Quality of Education	1.84	.176	.007
Language x Quality of Education	1.11	.292	.004
Sex x Language x Quality of Education	5.87	.160	.006

Again, for reasons outlined earlier, the effects of race were investigated within the advantaged group only. Table 63 shows that there were no statistically significant differences in Phonemic Fluency scores between coloured and white participants within the group with advantaged quality of education. Hence, there was no need for separate ANCOVAs including race as a covariate.

Table 63. *Phonemic Fluency Analyses of Variance: Between-race comparisons for participants with advantaged quality of education on total words generated for letters L, B, and S*

Outcome Measure	**Race**						**ANOVA Test Statistics**	
	Coloured			**White**				
	n	***M***	***SD***	***n***	***M***	***SD***	***F***	***p***
Phonemic Fluency	54	32.20	10.03	79	33.49	10.87	0.48	.489

Because age was shown to be associated with performance on Phonemic Fluency (see Table 62), it was necessary to determine how to cluster age-groups for the normative data. The results of the consequent post-hoc LSD analyses (see Table 64) demonstrated that there were statistically significant age-related differences in performance between 12-year-olds and the other age-groups, and between 14- and 15-year-olds. The means plots (see Figure 9) showed a linear progression differentiating between 12-year-olds, 13- to 14-year-olds, and 15-year-olds, necessitating three age-group divisions.

Table 64. *Phonemic Fluency Post-hoc LSD Analyses: Mean differences for age-group comparisons on total words generated for letters L, B, and S*

	Mean Difference	***p***
12 vs 13	-3.32	**.029**
12 vs 14	-3.20	**.039**
12 vs 15	-6.53	**<.001**
13 vs 14	0.12	.942
13 vs 15	-3.21	.050
14 vs 15	-3.33	**.045**

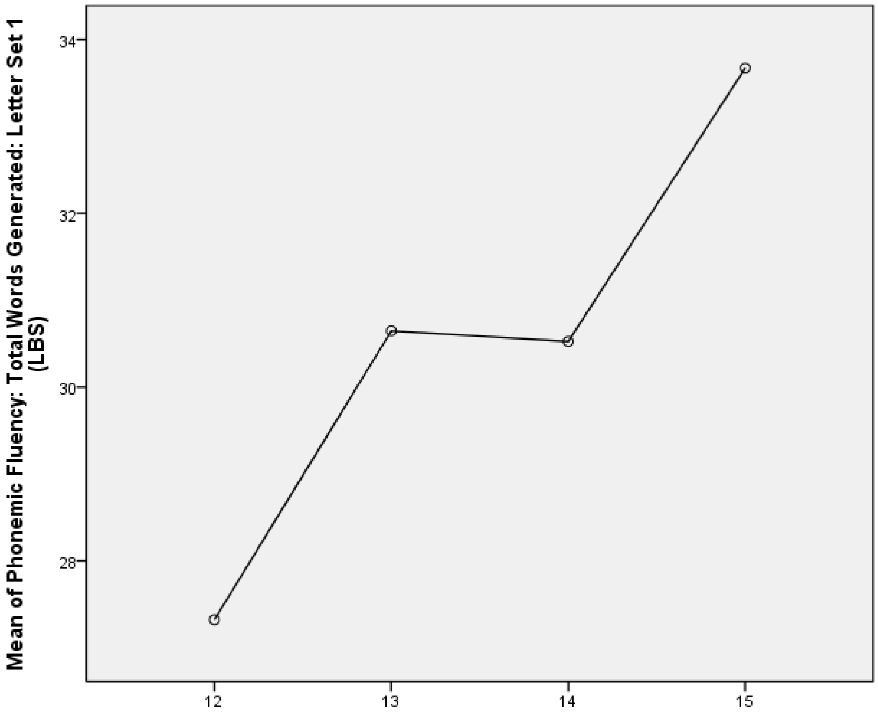

Figure 9. Phonemic Fluency means plot by age-group for total words generated for letters L, B, and S.

In accordance with the results reported above, it was necessary to stratify the norms for Phonemic Fluency by language, quality of education, and by three age-groups (12 years, 13 to 14 years, and 15 years), resulting in some particularly small cell sizes (see Table 64). Data for Afrikaans-speaking 12- and 15-year-olds with advantaged quality of education, for example, may have limited generalizability. Normative conversion tables for the twelve subgroups are located in Appendix D (Tables D-90 to D-101).

Table 65. *Phonemic Fluency Descriptive Normative Data: Stratified by age, language, and quality of education, for total words generated for letters L, B, and S*

Age	Language	Quality of Education	*n*	*M*	*SD*	Range
12	Afrikaans	Advantaged	8	30.13	8.11	20 – 46
		Disadvantaged	30	23.77	7.12	11 – 38
	English	Advantaged	37	30.57	9.34	13 – 49
		Disadvantaged	18	25.33	6.84	15 – 39
13 to 14	Afrikaans	Advantaged	20	32.65	9.36	14 – 15
		Disadvantaged	32	26.72	7.42	10 – 42
	English	Advantaged	41	31.37	7.73	16 – 46
		Disadvantaged	34	31.97	7.42	15 - 46
15	Afrikaans	Advantaged	8	34.38	9.58	22 – 50
		Disadvantaged	28	28.21	8.17	14 - 42
	English	Advantaged	19	42.05	15.50	17 – 90
		Disadvantaged	11	33.18	8.95	17 - 48

Note.; the sample (N = 286) included female and male participants; groups with advantaged quality of education included coloured and white participants; groups with disadvantaged quality of education included coloured participants.

Table 65 shows a general pattern of increments of performance with increased age, within the language-groups, and within the quality of education-groups. There appears to be a continuum of performance, with the English-Advantaged subgroup achieving the highest scores, followed very closely by the Afrikaans-Advantaged subgroups, then by the English-Disadvantaged, and the lowest scores are demonstrated by Afrikaans-Disadvantaged subgroups.

Within the aforementioned sociodemographic subgroups, number of words generated per age-group tended to increase by 1 to 5 words. The transition between English-Advantaged 13- to 14-year olds, and English-Advantaged 15-year-olds showed a 10-word increase, which is larger than the other mean differences, but still not clinically significant (< 1 SD). Although none of the mean differences between subgroups are clinically significant, the overall pattern of increases, and the continuum of performance by the sociodemographic subgroups suggest that the stratified norms may be clinically useful, despite some small cell sizes.

Overall findings have demonstrated that Phonemic Fluency continues to improve into the third decade (Mitrushina et al., 2005; Strauss et al., 2006) . The gradual increments in scores demonstrated within the subgroups in our study seem to suggest that this may be true for the local population, although this would need to be verified in longitudinal studies.

Our findings are consistent with the overall trends in the literature that do not report sex differences in Phonemic Fluency (D. Barry et al., 2008; Mitrushina et al., 2005; Strauss et al., 2006), and do not support Barr's (2003) seemingly isolated finding of a female advantage in adolescents.

The differences in performance between Afrikaans- and English-speakers in our study is consistent with wide reporting of inter-lingual differences in Phonemic Fluency (Lezak et al., 2004; Mitrushina et al., 2005; Strauss et al., 2006). Inter-lingual differences in performance have been linked with bilingualism, which tends to impact negatively on verbal generativity due, presumably, to interference between languages (Kempler et al., 1998; Portocarrero et al., 2007; Rosselli et al., 2002). Although I did not investigate the impact of bilingualism on Phonemic Fluency in this study, it would be useful to investigate whether the subtle differences in performance between English- and Afrikaans-speakers (when quality of education is held constant), may be attributable to the trend for Afrikaans-speakers in the Western Cape to be more bilingual than English-speakers. Our findings that lowered scores are associated with disadvantaged quality of education mirrors Cave and Grieve's (2009) findings for adolescents in Gauteng.

Table 66. *Phonemic Fluency Descriptive Normative Data: Error scores and individual letter scores*

Outcome Measure	*M*	*SD*	**Range**
Total Repetitions	0.34	0.68	0 - 4
Total Rule Violations	0.58	1.02	0 - 6
Total Set Loss Errors	0.06	0.26	0 - 2
Letter L	12.26	5.08	4 - 28
Letter B	14.95	4.39	9 - 27
Letter S	14.84	7.00	3 - 35

Note. The sample (*N* = 286) included 12- to 15-year-old, female and male, Afrikaans- and English-speaking, coloured and white participants with advantaged and disadvantaged quality of education.

Table 66 shows descriptive statistics for the whole sample for error scores, which were non-normally distributed; and for the three individual letters, to facilitate comparisons with other research on the same letter/s. Our findings are consistent with overall trends that typically developing participants rarely commit more than one error per letter (D. Barry et al., 2008; Berger, 1998; Mitrushina et al., 2005). It would be useful to evaluate the utility of the error scores in detecting subnormal response-inhibition in clinical samples in future studies.

3.1.10.1.2. Phonemic Fluency: Cross-cultural comparison of norms

It is impossible to make cross-cultural comparisons using the current letter set, as no other studies have used the particular combination designed to be appropriate for the specific linguistic profile of this study. However, as a rough estimation of the cross-cultural utility of Phonemic Fluency norms, I compared the data from the local sample with data published by Strauss et al. (Strauss et al., 2006, p. 515, Table 8.74). The latter norms were derived from data collected on Australian adolescents, using the letters F, A, and S.

For the t-test comparisons between the Western Cape and Australian norms (see Table 67), I used the four separate age-groups published by Strauss et al, and further subdivided the age-groups by language, and by quality of education.

Table 67. *Phonemic Fluency Cross-Cultural Utility: Comparisons between local and non-local norms*

Australian Norms* (Letters F, A, S)			**Western Cape Norms** (Letters L, B, S)**					**T-test Statistics**			
Age	***n***	***M (SD)***	**Lang**	**Q Ed**	***n***	***M***	***SD***	**Mean Diff**	***t***	***p***	***ESE***
12	54	30.13 (8.2)	Afr	Adv	8	30.13	8.11	-0.01	-0.00	.999	0.00
				Dis	30	23.77	7.12	-6.36	-4.89	**<.001**	0.80
			Eng	Adv	37	30.57	9.34	0.44	0.29	.777	0.05
				Dis	18	25.33	6.84	-4.80	-2.97	**.009**	0.60
13	51	28.98 (8.2)	Afr	Adv	10	33.50	8.10	4.52	1.77	.111	0.55
				Dis	13	23.85	7.13	-5.13	-2.60	**.023**	0.63
			Eng	Adv	29	32.52	7.08	3.54	2.69	**.012**	0.45
				Dis	13	31.08	7.56	2.10	1.00	.337	0.26
14	18	28.1 (1.7)	Afr	Adv	10	31.80	10.85	3.70	1.08	.309	0.55
				Dis	18	28.78	7.34	0.68	0.39	.700	0.12
			Eng	Adv	12	28.58	8.83	0.48	0.19	.853	0.08
				Dis	21	32.52	7.47	4.42	2.71	**.013**	0.77
15	14	30.6 (1.0)	Afr	Adv	8	34.38	9.58	3.78	1.12	.302	0.64
				Dis	29	28.17	8.03	-2.43	-1.63	.115	0.36
			Eng	Adv	19	42.05	15.50	11.45	3.22	**.005**	0.94
				Dis	11	33.18	8.96	2.58	0.96	.361	0.42

Note. ESE = Hedges' *g* effect size estimate; *compiled by Strauss et al. (2006); **the sample (N = 286) included female and male participants; Lang = Language; Afr = Afrikaans; Eng = English; Q Ed = Quality of Education; Adv = subgroups with advantaged quality of education, which included coloured and white participants; Dis = subgroups with disadvantaged quality of education, which included coloured participants.

For the comparisons of norms for 12- and 13-year-olds, I used the SDs from the standardization sample to evaluate whether the mean differences between local and non-local norms were clinically significant (i.e., > 1 SD), over and above being statistically significant. Table 67 shows that while mean differences were statistically significant for a few subgroups, none of them exceeded one SD, indicating that the differences were not clinically significant.

For Strauss et al.'s compiled data for 14- and 15-year-olds, the reported SDs are exceptionally small, in relation to the other tabulated non-local figures, and in comparison with the range of SDs from the local sample. These small SDs reflect very little variability in performance in the Australian sample. I did not interpret mean differences exceeding the given SDs in this context as being clinically significant or not.

The overall pattern of mean differences in the 14- to 15-year-olds shows that the means are slightly higher for the local sample in comparison with the Australian norms. The number of words generated by 15-year-old, English-Advantaged participants from the Western Cape is particularly large in comparison with the 15-year-old Australian sample. These results may indicate that the selection of letters according to frequency of use in the language profile of the participants reduces the cross-cultural variability of Phonemic Fluency normative data.

3.1.10.2. Semantic Fluency

3.1.10.2.1. Semantic Fluency: Relative influences of sociodemographic factors and stratified norms

Tables 68 to 70, which refer to the relative impact of sociodemographic variables on Semantic Fluency, indicate that older age, English language, advantaged quality of education, and white race predicted higher scores on Semantic Fluency, as a measure of executive functioning (specifically, set-shifting, as an indication of cognitive flexibility). When the effects of age, sex, language, and interaction effects were held constant, quality of education accounted for the largest portion of variance (10.3%) in number of animals named. The relative impact of the other sociodemographic extended from 7.8% for age, to 2.5% for language. Within the group with disadvantaged quality of education, race accounted for 3.1% of variance, followed by age (8.8%), and the main effect of language, in this context, became non-significant.

Table 68. *Semantic Fluency Analyses of Covariance: Effects of age, sex, language, and quality of education on animal-naming*

	F	*p*	ω^2
Main Effect			
Age	23.43	**<.001**	.078
Sex	0.18	.673	.001
Language	7.21	**.008**	.025
Quality of Education	31.93	**<.001**	.103
Interaction Effect			
Sex x Language	1.92	.167	.007
Sex x Quality of Education	1.26	.262	.005
Language x Quality of Education	0.01	.941	.000
Sex x Language x Quality of Education	2.78	.097	.010

Table 69. *Semantic Fluency Analyses of Variance: Between-race comparisons for participants with advantaged quality of education on animal-naming*

Outcome Measure	**Race**						**ANOVA Test Statistics**	
	Coloured			**White**				
	n	***M***	***SD***	***n***	***M***	***SD***	***F***	***p***
Semantic Fluency	54	16.74	3.86	79	18.75	6.41	4.24	**.042**

Table 70. *Semantic Fluency Analyses of Covariance for Participants with Advantaged Quality of Education: Effects of age, sex, language, and race on animal-naming*

	F	*p*	ω^2
Main Effect			
Age	12.00	**.001**	.088
Sex	0.24	.626	.002
Language	1.89	.172	.015
Race	4.00	**.048**	.031
Interaction Effect			
Sex x Language	1.65	.202	.013
Sex x Race	0.00	.964	.000
Language x Race	0.26	.613	.002
Sex x Language x Race	0.02	.900	.000

Because age was associated with Semantic Fluency, I needed to determine how to stratify the age-groups for the norms. Table 71 showed that performance for 12-year-olds differed significantly from the other age-groups. Figure 10 demonstrated a linear trend in performance, but with a steep incline after the age of 12. Norms were thus stratified by two age-groups (12-year-olds; and 13- to 15-year-olds). The age-related trajectory demonstrated in this sample is consistent with general trends exhibited in the literature showing steep inclines in early adolescence, followed by less pronounced improvements in older adolescents.

Table 71. *Semantic Fluency Post-hoc LSD Analyses: Mean differences for age-group comparisons on animal-naming*

	Mean Difference	***p***
12 vs 13	-2.20	**.007**
12 vs 14	-2.41	**.004**
12 vs 15	-3.04	**<.001**
13 vs 14	-0.20	.821
13 vs 15	-0.84	.336
14 vs 15	-0.64	.473

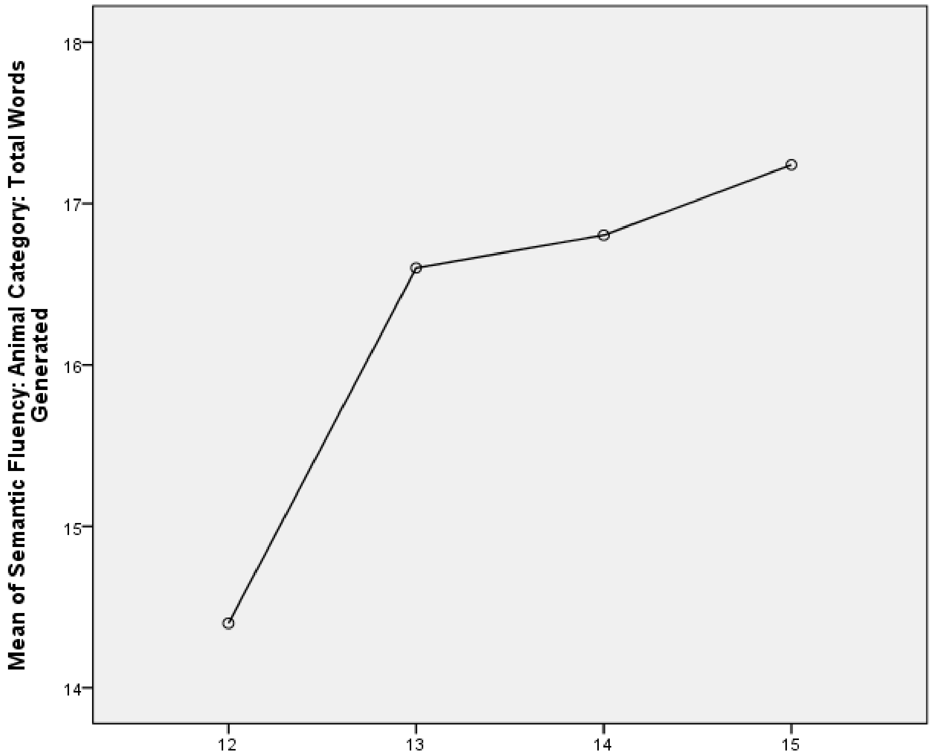

Figure 10. Semantic Fluency means plot by age-group for animal-naming.

Because Semantic Fluency was associated with multiple sociodemographic variables, in the interests of retaining cell sizes that allow for generalizability, I stratified the norms by the three most influential variables (age, divided into two groups, quality of education, and race) (see Table 72). It is possible that the norms may slightly underestimate performance for Afrikaans-speakers, for participants with disadvantaged quality of education (but not for those with advantaged quality of education, according to the results shown in Table 70). Normative conversion tables, stratified according to the same criteria as the descriptive norms, are presented in Appendix D (Tables D-102 to D-107).

Table 72. *Semantic Fluency Descriptive Normative Data: Stratified by age, race, and quality of education, for animal-naming*

Age	Race	Quality of Education	*n*	*M*	*SD*	Range
12	Coloured	Advantaged	14	16.21	5.47	9 – 30
		Disadvantaged	48	12.71	3.70	7 – 20
	White	Advantaged	31	16.19	5.56	6 – 27
13 to 15	Coloured	Advantaged	40	16.93	3.19	10 – 25
		Disadvantaged	105	15.27	3.85	6 – 26
	White	Advantaged	48	20.40	6.43	6 - 45

Note. The sample (*N* = 286) included female and male, Afrikaans- and English-speaking participants.

Table 72 shows a continuum of results based on the sociodemographic profiles, from most to least words generated as follows: 1) 13- to 15-year-old, white-advantaged; 2) 13- to 15-year-old coloured advantaged; 3) 12-year-old, white-advantaged; 4) 12-year-old coloured-advantaged; 5) 13- to 15-year-old, coloured-disadvantaged; and 6) 12-year-old, coloured-disadvantaged participants. All advantaged groups attained higher scores than disadvantaged groups, regardless of race. These findings, in collaboration with the ANCOVAs, indicate that quality of education appears to be the strongest predictor of Semantic Fluency, followed by age, and then race.

The complex interplay between sociodemographic variables and both types of Verbal Fluency have been demonstrated in other South African groups. Sperinck & De Picciotto (1999) found that black Zulu-speaking adults generated less words for Semantic Fluency than white English-speakers. Cave and Grieve (2009) demonstrated lower scores in Phonemic and Semantic Fluency by black-polyglot adolescents with disadvantaged quality of education, in comparison to mixed-race, English-speaking participants with advantaged quality of education. As discussed previously, the effects of bilingualism and other factors, such as reading speed and fluency, have been shown to impact Verbal Fluency (Portocarrero et al., 2007; Rodriguez-Aranda, 2003), and are worthy of detailed investigations in future studies.

Because more than two sociodemographic variables were associated with cognitive performance, it is difficult to evaluate clinical significance by SD-comparisons. The continuum of results would suggest, however, that the stratification criteria employed above are useful in that they allow practitioners to select norms according to the sociodemographic profile that closely matches that of the participant being assessed.

As with all error scores measured in the study, data for errors committed during Semantic Fluency tests were non-normally distributed. Descriptive statistics were, therefore, presented for the entire sample (see Table 73). The error rates committed by our participants during the animal-naming task were small, as is the pattern in cognitively intact populations (V. A. Anderson, Anderson, Northam, Jacobs, & Catroppa, 2001; Strauss et al., 2006).

Table 73. *Semantic Fluency Descriptive Normative Data: Error scores for animal-naming*

Outcome Measure	***M***	***SD***	**Range**
Total Repetitions	0.21	0.47	0 - 2
Total Rule Violations	0.01	0.10	0 - 1
Total Set Loss Errors	0.03	0.22	0 - 3

Note. The sample (N = 286) included 12- to 15-year-old, female and male, Afrikaans- and English-speaking, coloured and white participants with advantaged and disadvantaged quality of education.

3.1.10.2.2. Semantic Fluency: Cross-cultural comparison of norms

In order to investigate the validity of the common assumption that African norms are superior to non-African norms when testing African participants, I compared the study norms to two different sets of non-local normative data: 1) from Africa: Ruffieux and colleagues' (2010) norms for English-speakers from Cameroon; and 2) not from Africa: Kavé and colleagues' (2009) norms for Hebrew-speakers from Israel. The two sets of non-local norms were useful in that they reported normative data for the same age-groups (12- to 13-years; and 14- to 15-years) and employed a single semantic category (viz., animals). As such, the age-profile and test material were comparable across the three studies.

I used the SDs from the standardization sample to evaluate whether the mean differences between local and non-local norms were both statistically and clinically significant (i.e., > 1 SD). Table 74 demonstrates that the Cameroonian norms are vastly different from the study norms, being statistically and clinically significant (> 1 or 2 SDs). These results indicate that it would be highly inadvisable to use the Ruffieux et al.'s (2010) norms to interpret Semantic Fluency results for participants matching the sociodemographic profile of the study sample. Considering that, even for participants with disadvantaged quality of education, the local sample generated approximately double the number of animals in comparison to the Cameroonian adolescents, the use of these particular non-local norms would increase the probability of false-negative diagnoses of participants with executive dysfunction.

The *t*-test comparisons between local norms and Kavé et al.'s (2009) Hebrew norms revealed that the two sets of data are remarkably similar. Mean differences were either non-significant, or statistically, but not clinically significant (all mean differences were less than one SD). These findings invalidate the assumption that African norms are superior to non-African norms when assessing participants who live in Africa.

Table 74. *Semantic Fluency Cross-Cultural Utility: Comparisons between local and non-local norms*

Non-local Norms			**Western Cape Norms***					**T-test Statistics**			
Age	***n***	***M (SD)***	**Race**	**Q Ed**	***n***	***M***	***SD***	**Mean Diff**	***t***	***p***	***ESE***
Ruffieux et al.'s (2010) Cameroonian Norms											
12 to 13	21	7.3 (4.4)	Col	Adv	28	16.21	4.37	8.91	10.80	**<.001**	2.00
				Dis	74	13.30	3.68	5.99	14.01	**<.001**	1.55
			White	Adv	56	17.50	5.85	10.20	13.05	**<.001**	1.84
14 to 15	22	11.0 (4.9)	Col	Adv	26	17.31	3.22	6.31	9.98	**<.001**	1.52
				Dis	79	15.56	3.95	4.56	10.24	**<.001**	1.08
			White	Adv	23	21.78	6.81	10.78	7.60	**<.001**	1.78
Kavé et al.'s (2009) Israeli Norms											
12 to 13	30	17.7 (4.9)	Col	Adv	28	16.21	4.37	-1.49	-1.80	.083	0.32
				Dis	74	13.30	3.68	-4.40	-10.29	**<.001**	1.07
			White	Adv	56	17.50	5.85	-0.20	-0.26	.799	0.04
14 to 15	30	18.8 (4.9)	Col	Adv	26	17.31	3.22	-1.49	-2.36	**.026**	0.35
				Dis	79	15.56	3.95	-3.24	-7.29	**<.001**	0.76
			White	Adv	23	21.78	6.81	2.98	2.10	**.047**	0.51

Note. ESE = Hedges' *g* effect size estimate; *the sample (*N* = 286) included female and male, Afrikaans- and English-speaking participants; Col = coloured participants; Q Ed = Quality of Education; Adv = groups with advantaged quality of education; Dis = groups with disadvantaged quality of education.

The results of both types of Verbal Fluency from this study are consistent with general findings articulated in the literature indicating that Phonemic Fluency is more difficult than Semantic Fluency and have different neuroanatomical correlates (Billingsley et al., 2004; Klumpp & Deldin, 2010). The number of words generated per letter tends to be approximately 12 to 16 (whole sample mean for this study = 14.02 ± 5.49), and the typical number of animals generated tends to be between 18 and 20 (mean for this study = 16.8 8 ± 5.09). These findings suggest that it is inappropriate to use the two types of fluency interchangeably, or to use norms from one type to interpret performance on the other. Overall, the results of this study confirm that if the letters and categories are carefully selected, Verbal Fluency tests can be used successfully cross-culturally. It would be useful to investigate the utility of Semantic and Phonemic Fluency as mechanisms of identifying set-shifting difficulties, which may indicate deficits in cognitive flexibility in clinical samples.

3.1.11. Wechsler Abbreviated Scale of Intelligence (WASI)

3.1.11.1. WASI: Relative influences of sociodemographic factors and stratified norms

Table 75. *WASI Analyses of Covariance: Effects of age, sex, language, and quality of education*

	Block Design			Matrix Reasoning		
	F	***p***	ω^2	***F***	***p***	ω^2
Main Effect						
Age	16.00	**<.001**	.055	2.53	.113	.009
Sex	0.73	.395	.003	0.05	.833	.000
Language	10.52	**.001**	.037	16.92	**<.001**	.058
Quality of Education	49.59	**<.001**	.152	34.70	**<.001**	.111
Interaction Effect						
Sex x Language	3.04	.056	.014	1.02	.315	.004
Sex x Quality of Education	0.22	.643	.001	0.13	.720	.000
Language x Quality of Education	0.56	.457	.002	0.34	.563	.001
Sex x Language x Quality of Education	0.86	.356	.003	0.04	.839	.000
	Similarities			**Vocabulary**		
	F	***p***	ω^2	***F***	***p***	ω^2
Main Effect						
Age	3.82	.053	.013	23.47	**<.001**	.078
Sex	6.79	**.010**	.024	6.57	**.011**	.023
Language	42.01	**<.001**	.132	66.70	**<.001**	.194
Quality of Education	52.33	**<.001**	.159	72.90	**<.001**	.208
Interaction Effect						
Sex x Language	10.55	**.001**	.037	4.26	**.040**	.015
Sex x Quality of Education	1.44	.231	.005	2.95	.087	.011
Language x Quality of Education	3.45	.064	.012	3.30	.071	.012
Sex x Language x Quality of Education	5.04	**.026**	.018	3.73	.054	.013

Table 75 shows that performance on the WASI subtests was affected by a complex array of sociodemographic variables. For all four subtests, the main effect of quality of education accounted for the highest portions of score variance (ranging from 11.1 to 20.8%). Language exerted a strong main effect on the verbal subtests (19% for Vocabulary, and 13.2% for Similarities) and also significantly affected the nonverbal subtests, but to a lesser extent (3.7% for Block Design; and 5.8% for Matrix Reasoning). Age was associated with performance on Block Design (5.5%) and Vocabulary (7.8%), and sex predicted 2.4% of the variance in Similarities scores, and 2.3% in Vocabulary scores. The results of the ANCOVAs for the verbal subtests were difficult to interpret, due to multiple main effects, and significant interaction effects. In all cases where main effects were significant, poorer performance was predicted by younger age, male sex, Afrikaans language, and disadvantaged quality of education.

Because of the unequal racial distribution within the whole sample and because there were no white participants with disadvantaged quality of education, the effects of race were investigated only for participants with advantaged quality of education. Table 76 shows that there were significant differences in performances between coloured and white participants with advantaged quality of education, warranting further analyses to investigate the relative influences of race and the other sociodemographic variables on all four WASI subtests.

Table 76. *WASI Analyses of Variance: Between-race comparisons for participants with advantaged quality of education*

Outcome Measure	**Race**						**ANOVA Test Statistics**	
	Coloured			**White**				
	n	***M***	***SD***	***n***	***M***	***SD***	***F***	***p***
Block Design	54	29.94	14.98	79	41.72	13.13	23.00	**<.001**
Matrix Reasoning	54	19.80	6.09	79	24.63	5.19	24.20	**<.001**
Similarities	54	27.81	5.67	79	32.66	6.56	19.50	**<.001**
Vocabulary	54	44.59	9.14	79	48.44	10.11	5.03	**.027**

Note. Data are presented as raw scores.

Table 77 shows that in relation to the other significant main effects, within the group with advantaged quality of education, race was by far the most influential covariate in the performance/nonverbal subtests, with poorer performance predicted by coloured race. For Block Design, race accounted for 14.0% of the variance, in comparison to age (4.5%) and language (3.3%). Race contributed 17.5% of variance in performance on Matrix Reasoning, compared to language (5.1%) and age (1.6%). For the Similarities subtest, race contributed 11.0%, followed by sex (5.3%), and age (1.9%). The Vocabulary subtest demonstrated a different profile with regards to the relative strength of the sociodemographic variables, with language contributing to the highest portion of variance (9.9%), followed by race (6.8), age (5.4%), and sex (4.2%). To complicate interpretation even further, the sex x language interaction effect was significant for the Similarities subtest.

Table 77. *WASI Analyses of Covariance for Participants with Advantaged Quality of Education: Effects of age, sex, language, and race*

	Block Design			Matrix Reasoning		
	F	***p***	***ω²***	***F***	***p***	***ω²***
Main Effect						
Age	5.83	**.017**	.045	1.96	.164	.016
Sex	0.17	.680	.001	0.16	.687	.001
Language	4.22	**.042**	.033	6.71	**.011**	.051
Race	20.18	**<.001**	.140	26.34	**<.001**	.175
Interaction Effect						
Sex x Language	0.97	.326	.008	0.26	.613	.002
Sex x Race	0.27	.607	.002	3.19	.077	.025
Language x Race	0.31	.579	.002	0.68	.410	.005
Sex x Language x Race	1.28	.260	.010	0.39	.533	.003
	Similarities			**Vocabulary**		
	F	***p***	***ω²***	***F***	***p***	***ω²***
Main Effect						
Age	2.98	.057	.019	7.03	**.009**	.054
Sex	6.94	**.010**	.053	5.43	**.021**	.042
Language	6.80	**.010**	.052	13.68	**<.001**	.099
Race	15.26	**<.001**	.110	9.09	**.003**	.068
Interaction Effect						
Sex x Language	8.95	**.003**	.067	3.26	.073	.026
Sex x Race	1.28	.261	.010	0.86	.357	.007
Language x Race	0.00	.961	.000	2.77	.099	.022
Sex x Language x Race	1.00	.320	.008	0.46	.500	.004

Because age effects were not significant for Matrix Reasoning and Similarities (see Table 75), normative data for these subtests were presented in one age-group (12 to 15 years). For Block Design and Vocabulary, younger age predicted poorer performance, but it was necessary to determine how to subdivide the subgroups for norm-stratification purposes. The results of the post-hoc LSD analyses (see Table 78) and the means plots (see Figures 11 and 12) demonstrate a distinct developmental upward shift after the age of 12, and relatively stable performance between the ages of 13 and 15. Normative data were thus stratified by two age groups (12 years; and 13 to 15 years) (see Tables 79 and 82).

Table 78. WASI *Post-hoc LSD Analyses: Mean differences for age-group comparisons*

	Block Design		Vocabulary	
	Mean Difference	***p***	**Mean Difference**	***p***
12 vs 13	-6.91	**.004**	-3.81	**.043**
12 vs 14	-5.58	**.023**	-4.12	**.032**
12 vs 15	-6.65	**.005**	-4.57	**.014**
13 vs 14	1.33	.615	-0.31	.880
13 vs 15	0.25	.922	-0.76	.705
14 vs 15	-1.08	.680	-0.45	.826

Note. Data are presented as raw scores.

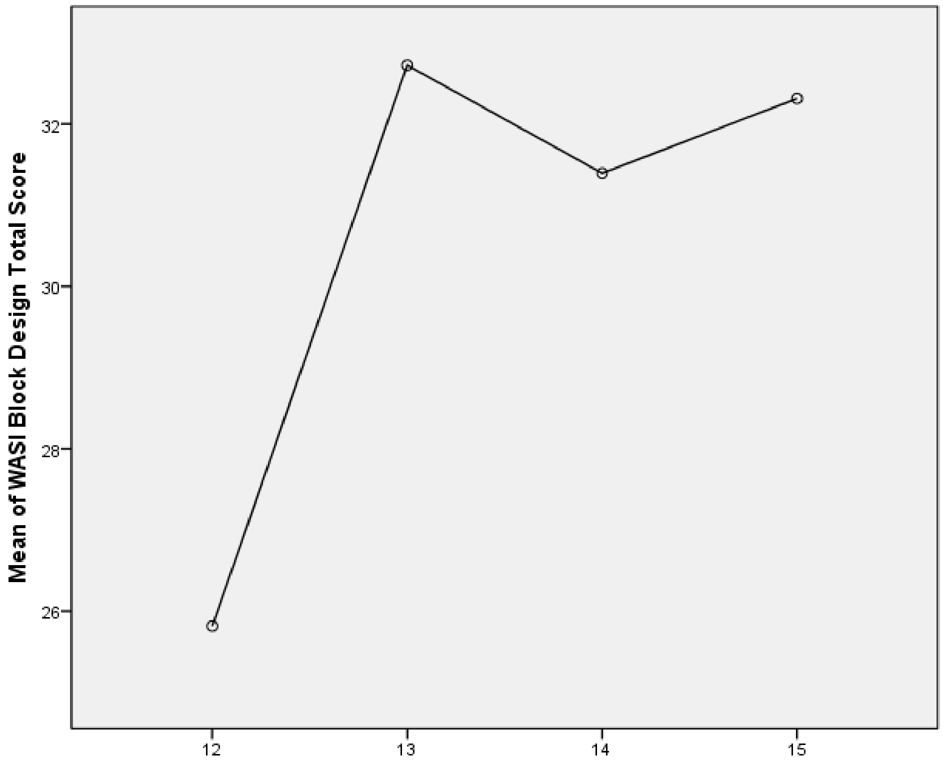

Figure 11. WASI means plot by age-group for Block Design (raw scores).

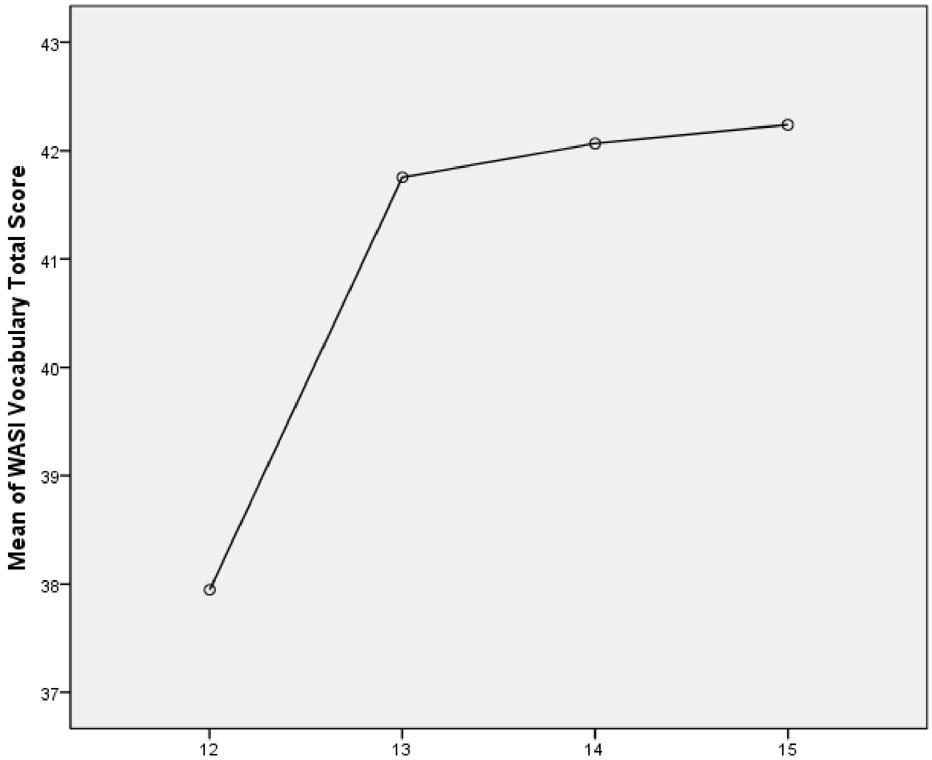

Figure 12. WASI means plot by age-group for Vocabulary (raw scores).

The nature and complexity of multiple influential sociodemographic effects on the WASI created some pragmatic and interpretive problems. In other situations in this study where interaction effects were significant, I did not present stratified normative data as a result of such interpretive problems (e.g., CMS Stories). However, both WASI verbal subtests demonstrated significant interaction effects, and it was necessary to use these data to calculate composite IQ scores (VIQ and FSIQ). The experimental verbal subscales would need to be evaluated carefully for item bias in future studies, and I would recommend interpretive caution for these scales in the interim.

Another complication in the norming process is that as the number of stratification subgroups increases, the cell sizes diminish, thereby limiting the generalizability of the data. In order to retain adequate cell sizes where possible, I did not stratify the norms by all of the statistically significant sociodemographic variables for Block Design, Similarities, and Vocabulary. For each subtest, I evaluated the relative impact of the covariates, and presented data for the whole sample on the least influential covariate in each subtest. Due to the interpretive complexities associated with multiple effects, I did not speculate about whether mean differences between subgroups were clinically significant. Instead, I reported the raw score means on a continuum of performance, to illustrate the variability of scores in relation to the different sociodemographic subgroups.

Descriptive norms for Block Design (see Table 79) were stratified by two age-groups (12 years; and 13 to 15 years), race, quality of education, but not by language (which was the least influential significant main effect), or by sex (which was non-significant). It is possible that the norms may underestimate visuo-spatial organizational abilities and nonverbal reasoning (as measured by the Block Design subtest) for English-speakers, and overestimate these abilities in Afrikaans-speakers. Data for 12-year-old, coloured participants with advantaged quality of education has limited generalizability due to the small cell size (*n* = 14). Due to these complications, interpretation of performance on Block Design based on these normative data should be made with caution.

Our findings contrast literature reviewed by Snow and Weinstock (1990) indicating male advantage for Block Design in adults, and are consistent with findings from the WASI standardization study (Psychological Corporation, 1999) indicating the absence of sex effects on Block Design for the sample (ranging from the ages of 8 to 89).

The raw scores in Table 79 indicate a continuum of performance on the Block Design subtest, from highest (mean = 45.04) to lowest (mean = 18.04) as follows: 1) 13- to 15-year-old white-advantaged; 2) 12-year-old white-advantaged; 3) 13- to 15-year-old coloured-advantaged; 4) 12-year-old coloured-advantaged; 5) 13- to 15-year-old coloured-disadvantaged; 6) 12-year-old coloured-disadvantaged. These results demonstrate that due to the variability in performance between the subgroups, it would be advisable to use the stratified norms. Norm conversion tables, stratified as in Table 79, are located in Appendix D (Tables D-108 to D-113).

Table 79. *WASI Block Design Descriptive Normative Data: Stratified by age, race, and quality of education*

Age	**Race**	**Quality of Education**	**n**	**M**	**SD**	**Range**
12	Coloured	Advantaged	14	28.57	15.04	6 – 56
		Disadvantaged	48	18.06	10.21	5 – 44
	White	Advantaged	31	36.58	12.29	11 – 56
13 to 15	Coloured	Advantaged	40	30.43	15.12	6 – 64
		Disadvantaged	105	26.93	12.26	8 – 63
	White	Advantaged	48	45.04	12.69	8 - 64

Note. Data are presented as raw scores; the sample (*N* = 286) included female and male, Afrikaans- and English-speaking participants.

For the Matrix Reasoning subtest, it was possible to stratify the norms by all the significant sociodemographic variables (see Table 75) and to maintain adequate cell sizes. The norms are likely to appropriately characterize perceptual organization abilities and visual analogical reasoning, as measured by the Matrix Reasoning subtest, within the profiled subgroups. The norms presented in Table 80 are stratified by language, race, and quality of education. Corresponding norm conversion tables are located in Appendix D (Tables D-114 to D-119).

Table 80 shows a continuum of performance, from highest (mean = 25.12) to lowest (mean = 16.43) for the Matrix Reasoning subtest, as follows: 1) English-white-advantaged; 2) Afrikaans-white-advantaged; 3) English-coloured-advantaged; 4) English-coloured-disadvantaged; 5) Afrikaans-coloured-advantaged; 6) Afrikaans-coloured-disadvantaged. The results show less variability in performance for Matrix Reasoning than for Block Design, possibly because the former task is not subjected to time limits.

Table 80. *WASI Matrix Reasoning Descriptive Normative Data: Stratified by language, race, and quality of education*

Language	Race	Quality of Education	n	M	SD	Range
Afrikaans	Coloured	Advantaged	16	16.69	6.57	7 – 29
		Disadvantaged	90	16.43	5.53	4 – 30
	White	Advantaged	20	23.20	4.58	14 – 30
English	Coloured	Advantaged	38	21.11	5.44	6 – 29
		Disadvantaged	63	18.95	5.60	8 – 29
	White	Advantaged	59	25.12	5.32	10 – 33

Note. Data are presented as raw scores; the sample (N = 286) included 12- to 15-year-old, female and male participants.

As demonstrated in Tables 75 and 77 above, due to the multiple main and interaction effects associated with performance on the Similarities subtest, it was not possible to stratify norms by all the statistically significant covariates. It was essential to stratify data by race and quality of education, due to the magnitude of the effect sizes (quality of education = 15.9%; and race = 11.0% for participants with advantaged education). As sex was the least influential main effect (2.4% for the whole group), I stratified norms by language, race, and quality of education (see Table 80). The corresponding normative tables are located in Appendix D (Tables D-120 to D-125). Due to the three-way interaction effects exhibited in the ANCOVAs, and the failure to stratify norms by sex, the data for Similarities should be interpreted with due caution. The norms may, for example, underestimate abstract verbal reasoning abilities in females, and overestimate such abilities in males.

Table 81 shows a continuum of performance in the Similarities subtest, ranging from highest (mean = 33.22) to lowest (21.09) as follows: 1) English-white-advantaged; 2) Afrikaans-white-advantaged; 3) English-coloured-advantaged; 4) English-coloured-disadvantaged; 5) Afrikaans-coloured-advantaged; and 6) Afrikaans-coloured-disadvantaged.

Table 81. *WASI Similarities Descriptive Normative Data: Stratified by language, race, and quality of education*

Language	**Race**	**Quality of Education**	**n**	**M**	**SD**	**Range**
Afrikaans	Coloured	Advantaged	16	25.05	5.89	15 – 37
		Disadvantaged	90	21.09	5.94	3 – 34
	White	Advantaged	20	31.00	5.40	26 – 42
English	Coloured	Advantaged	38	29.00	5.20	17 – 37
		Disadvantaged	63	27.68	7.11	6 – 48
	White	Advantaged	59	33.22	6.86	9 - 48

Note. Data are reported as raw scores; the sample (*N* = 286) included 12- to 15-year-old, female and male participants.

The ANCOVAs demonstrated that Vocabulary was associated with age, sex, language, quality of education, and race. I did not stratify the norms by sex, as it contributed the lowest portion of variance (2.3%). The other main effects accounted for between 6.8 and 20.8% of the variance, so it was important to stratify data by all those covariates. However, the multiple subgroups resulted in particularly small cell sizes in the 12-year-old group. Specifically, the data for two of the 12-year-old subgroups are likely to have particularly restricted generalizability (n = 3 for the Afrikaans-coloured-advantaged subgroup; and n = 5 for the Afrikaans-white-advantaged subgroup). Furthermore, it is possible that the norms may underestimate acquired verbal abilities in females and overestimate them in males. Descriptive norms are presented in Table 82 and the corresponding conversion tables are located in Appendix D (Tables D-126 to D-137).

The slight female advantage demonstrated for Similarities and Vocabulary contrasts findings from the WASI standardization study, which indicated no sex effects on any subtests across the age range from 8 to 89 (Psychological Corporation, 1999). The differences in findings may be attributable to the relatively small main effect sizes of sex on performance, and to the significant interaction effects between sex, language and quality of education.

Table 82. *WASI Vocabulary Descriptive Normative Data: Stratified by age, language, race, and quality of education*

Age	Language	Race	Quality of Education	n	M	SD	Range
12	Afrikaans	Coloured	Advantaged	3	37.33	12.70	30 – 52
			Disadvantaged	30	28.20	6.32	13 – 47
		White	Advantaged	5	41.60	9.02	32 – 56
	English	Coloured	Advantaged	11	48.00	8.08	33 – 61
			Disadvantaged	18	35.06	7.64	18 – 46
		White	Advantaged	26	46.31	9.94	21 – 63
13 to 15	Afrikaans	Coloured	Advantaged	13	36.69	7.86	26 – 49
			Disadvantaged	60	32.07	8.56	17 – 52
		White	Advantaged	15	48.47	10.00	26 – 67
	English	Coloured	Advantaged	27	47.81	7.15	28 – 57
			Disadvantaged	45	44.51	9.32	23 – 60
		White	Advantaged	33	51.15	9.96	20 - 72

Note. Data are presented as raw scores; the sample (*N* = 286) included female and male participants.

The data in Table 82 show considerable variability of performance, ranging between mean raw scores of 51.15 (for the 13- to 15-year-old English-white-advantaged subgroup) to 28.20 (for the 12-year-old Afrikaans-coloured-disadvantaged subgroup). Despite the measures taken to attempt to reduce cultural and linguistic bias in the WASI verbal subtests, the results indicate that further analysis of the test material is necessary to try to explain the wide variability in performances between different subgroups. Analyses of item difficulty levels, linguistic issues related to multilingualism, language proficiency, and quality of language, all warrant further investigation.

3.1.11.2. WASI: Cross-cultural comparison of norms

In order to investigate the cross-cultural utility of the Western Cape norms derived from the current data for each of the WASI subtests, I compared these local data with the WASI standardization data from the USA (Psychological Corporation, 1999). I converted the raw scores to T-scores for the four subtests, using the normative conversion tables in Appendix D. Because the USA standardization data were smoothed to fit the normal distribution, I used the T-score corresponding to the 50th percentile as an indication of average performance in the non-local sample (mean = 50, SD = 10). For the t-test comparisons, I retained the stratification subgroups for the local data, as presented in the norms.

Table 83. *WASI Block Design Cross-Cultural Utility: Comparisons between local (study sample) norms and Psychological Corporation (1999) USA standardization norms*

USA Norms			Western Cape Norms*					T-test Statistics			
Age	***n***	**M (SD)**	**Race**	**Q Ed**	***n***	**M**	**SD**	**Mean Diff**	***t***	***p***	***ESE***
12	100	50 (10)	Col	Adv	14	47.54	11.03	-2.43	-0.82	.425	0.24
				Dis	48	40.17	7.81	-9.83	-8.73	**<.001**	1.05
			White	Adv	31	53.68	8.51	3.68	2.41	**.023**	0.38
13	100	50 (10)	Col	Adv	14	48.43	11.75	-1.57	-0.50	.625	0.15
				Dis	26	42.04	8.28	-7.96	-4.90	**<.001**	0.82
			White	Adv	25	54.88	8.11	4.88	3.01	**.006**	0.50
14	100	50 (10)	Col	Adv	10	42.40	8.59	-7.60	-2.80	**.021**	0.76
				Dis	39	42.31	8.47	-7.69	-5.67	**<.001**	0.80
			White	Adv	12	54.17	9.18	4.17	1.57	.144	0.42
15	100	50 (10)	Col	Adv	16	42.00	10.68	-8.00	-2.99	**.009**	0.79
				Dis	40	40.33	7.65	-9.68	-8.00	**<.001**	1.02
			White	Adv	11	55.63	7.98	5.64	2.34	**.041**	0.57

Note.; Data are presented as T-scores; ESE = Hedges' *g* effect size estimate; *the sample (*N* = 286) included female and male participants, Afrikaans- and English-speaking participants; Col = coloured; Q Ed = Quality of Education.

Table 83 demonstrates that for Block Design, the white-advantaged groups attained higher scores in comparison to the T-score average (50), and in comparison to the coloured-advantaged groups, who, in turn, outperformed the coloured-disadvantaged groups. The means for the coloured-disadvantaged groups were substantially lower than the average T-score of 50, for all four age-groups. Mean differences ranged from 7.60 to 9.83, and were all statistically significant, with large effect sizes. For the coloured-advantaged group, means for the 14 and 15-year-olds were also significantly lower (7.60 and 8.00) in comparison to expected T-scores, with large effect sizes. However, for the younger age-groups (12 and 13 years), the mean differences (1.57 and 2.43) and effect sizes were small. For white-advantaged groups (across all four age-groups), mean scores were higher (3.64 to 5.64) than the average T-score. The mean differences for 12-, 13-, and 15-year-olds were statistically significant, and for all age-groups, the effect sizes were moderate. These results imply that the local norms are preferable to the WASI standardized norms for coloured-disadvantaged participants and for coloured-advantaged 14- to 15-year-olds, but that the non-local norms are compatible with the local norms for coloured-advantaged 12- to 13-year-olds, and for white-advantaged participants.

The findings described above are highly consistent with trends exhibited by 12- to 13-year-olds from the Eastern Cape (Shuttleworth-Edwards et al., in press). Although Shuttleworth-Edwards and colleagues used the WISC-IV Block Designs (which differ from the WASI version in terms of block size, number of items, and stimulus designs), and reported their findings in scaled scores, the trends with regard to performance differences between the sociodemographic subgroups are similar. Mean scaled scores for the white-English-advantaged (11.83) and white-Afrikaans-advantaged groups (10.17) were higher than the scaled score mean (10). Mean scores for the coloured-Afrikaans-advantaged group (7.11) were lower than for the white groups, and lower than the scaled score mean (10), but higher than those of the coloured-Afrikaans-disadvantaged group (4.92), which was substantially lower than the scaled score mean (10). It would be very useful to collect and compare data for 12- to 13-year-old black-Xhosa participants from the Western Cape, to evaluate the inter-provincial cross-cultural utility of the Block Design measure.

Table 84 demonstrates a hierarchy of performance for Matrix Reasoning similar to the one demonstrated for Block Design as follows: 1) Highest scores were attained by the white-English-advantaged groups across all age-groups. Mean scores ranged from 50.00 to 51.85, thus were very similar to the T-score mean (50). Mean differences were thus non-significant, with small effect sizes. 2) Mean scores for the white-Afrikaans-advantaged groups (42.25 to 51.60) were slightly lower than for the white-English-advantaged group, but not significantly different from the T-score mean, with small to moderate effect sizes. 3) Means for the coloured-English-advantaged groups (31.50 to 45.20) were statistically lower than the T-score mean and mean differences were larger in the 12- and 13-year-olds (9.73 and 10.50) with large effect sizes, than for the 14- and 15-year-olds (4.80 and 6.25), with moderate effect sizes. 4) Means for the coloured-Afrikaans-advantaged groups (29.75 to 20.23) were markedly different from the T-score mean. 5) Mean differences ranged from 8.50 to 20.23, and effect sizes were large. English-coloured-disadvantaged groups attained means (37.92 to 39.40) that differed significantly from the T-score mean, with large effect sizes. Mean differences for this subgroup ranged from 10.83 to 11.73. 6) The lowest scores were obtained by the Afrikaans-coloured-disadvantaged group (means: 31.48 to 34.22). Mean differences between these local norms and T-score means (15.80 to 18.52) were very large, with large effect sizes.

Again, as was the case for Block Design, these findings replicated trends shown in the Shuttleworth-Edwards et al. (in press) study. For example, the white-English-advantaged group obtained mean scales scores (10.75) higher than the WISC-IV Matrix Reasoning mean (10); but the other groups scored means below 10, on a descending continuum from the white-Afrikaans-advantaged group (mean = 8.92), whose performance was similar to coloured-Afrikaans-advantaged group (mean = 8.33), and the worst scores were obtained by the coloured-Afrikaans-disadvantaged group (mean = 5.33).

Our findings add to the body of evidence that nonverbal tests such as Block Design and Matrix Reasoning are not devoid of cultural bias (Nell, 2000; Rosselli & Ardila, 2003; Shuttleworth-Edwards, Kemp et al., 2004), and underscore the importance of stratifying local normative data by the relevant sociodemographic factors, particularly language, race and quality of education within the South African context.

Table 84. *WASI Matrix Reasoning Cross-Cultural Utility: Comparisons between local (study sample) norms and Psychological Corporation (1999) USA standardization norms*

USA Norms		**Western Cape Norms***						**T-test Statistics**			
Age	**M (SD) [*n*]**	**Lang**	**Race**	**Q Ed**	***n***	**M**	**SD**	**Mean Diff**	***t***	***p***	***ESE***
12	50 (10) [100]	Afr	Col	Adv	3	34.00	14.18	-16.00	-1.96	.190	1.57
				Dis	30	34.20	10.50	-15.80	-8.24	**<.001**	1.55
			White	Adv	5	46.20	9.15	-3.80	-0.93	.406	0.38
		Eng	Col	Adv	11	40.27	13.02	-9.73	-2.48	**.033**	0.94
				Dis	18	39.10	11.51	-10.83	-3.99	**.001**	1.06
			White	Adv	26	51.85	11.36	1.85	0.83	.415	0.18
13	50 (10) [100]	Afr	Col	Adv	4	41.50	12.40	-8.50	-1.37	.264	0.84
				Dis	13	32.15	10.31	-17.85	-6.24	**<.001**	1.77
			White	Adv	6	42.50	10.71	-7.50	-1.72	.147	0.74
		Eng	Col	Adv	10	39.50	9.12	-10.50	-3.64	**.005**	1.05
				Dis	13	37.92	10.17	-12.08	-4.28	**<.001**	1.20
			White	Adv	19	51.16	7.89	1.16	0.64	.530	0.12
14	50 (10) [100]	Afr	Col	Adv	5	30.00	11.58	-20.00	-3.86	**.018**	1.97
				Dis	18	34.22	8.89	-15.78	-7.53	**<.001**	1.59
			White	Adv	5	51.60	6.23	1.60	0.57	.596	0.16
		Eng	Col	Adv	5	45.20	7.82	-4.80	-1.37	.242	0.48
				Dis	21	35.95	9.56	-14.05	-6.73	**<.001**	1.41
			White	Adv	7	43.00	14.48	-7.00	-1.28	.248	0.67
15	50 (10) [100]	Afr	Col	Adv	4	29.75	9.64	-20.25	-4.20	**.025**	2.01
				Dis	29	31.48	8.74	-18.52	-11.41	**<.001**	1.89
			White	Adv	4	42.25	8.54	-7.75	-1.82	.167	0.77
		Eng	Col	Adv	12	43.75	7.64	-6.25	-2.83	.016	0.63
				Dis	11	38.27	10.17	-11.73	-3.83	.003	1.16
			White	Adv	7	51.57	9.71	1.57	0.43	.683	0.16

Note. Data are presented as T-scores; ESE = Hedges' *g* effect size estimate; *the sample (*N* = 286) included female and male participants; Col = coloured; Q Ed = Quality of Education.

Table 85. *WASI Similarities Cross-Cultural Utility: Comparisons between local (study sample) norms and Psychological Corporation (1999) USA standardization norms*

USA Norms		**Western Cape Norms***						**T-test Statistics**			
Age	**M (SD) [*n*]**	**Lang**	**Race**	**Q Ed**	***n***	**M**	**SD**	**Mean Diff**	***t***	***p***	***ESE***
12	50 (10) [100]	Afr	Col	Adv	3	46.68	11.15	-3.33	-0.52	.656	0.33
				Dis	30	35.57	7.40	-14.43	-10.69	**<.001**	1.51
			White	Adv	5	47.80	2.68	-2.20	-1.83	.141	0.22
		Eng	Col	Adv	11	48.18	10.68	-1.82	-0.57	.585	0.18
				Dis	18	43.28	14.75	-6.72	-1.93	.070	0.62
			White	Adv	26	54.38	10.78	4.38	2.07	**.049**	0.43
13	50 (10) [100]	Afr	Col	Adv	4	49.75	9.74	-0.25	-0.05	.962	0.02
				Dis	13	36.00	9.70	-14.00	-5.20	**<.001**	1.39
			White	Adv	6	59.00	11.54	9.00	2.12	.087	0.98
		Eng	Col	Adv	10	45.20	8.21	-4.80	-1.85	.097	0.48
				Dis	13	42.77	8.41	-7.23	-3.10	**.009**	0.73
			White	Adv	19	57.63	9.70	7.63	3.43	**.003**	0.76
14	50 (10) [100]	Afr	Col	Adv	5	33.00	7.78	-17.00	-4.89	**.008**	1.70
				Dis	18	33.17	8.87	-16.83	-8.05	**<.001**	1.70
			White	Adv	5	41.40	2.88	-8.60	-6.68	**.003**	0.87
		Eng	Col	Adv	5	39.00	8.60	-11.00	-2.86	**.046**	1.10
				Dis	21	45.48	9.56	-4.52	-2.11	**.048**	0.45
			White	Adv	7	56.43	17.49	6.43	0.97	.368	0.60
15	50 (10) [100]	Afr	Col	Adv	4	31.25	6.85	-18.75	-5.48	**.012**	1.88
				Dis	29	30.69	9.00	-19.31	-11.55	**<.001**	1.96
			White	Adv	4	49.75	12.84	-0.25	-0.04	.971	0.02
		Eng	Col	Adv	12	49.17	6.60	-0.83	-0.44	.670	0.08
				Dis	11	46.27	8.65	-3.73	-1.43	.183	0.37
			White	Adv	7	59.29	11.09	9.29	2.22	.069	0.92

Note. Data are presented as T-scores; ESE = Hedges' *g* effect size estimate; *the sample (N = 286) included female and male participants; Col = coloured; Q Ed = Quality of Education.

Table 85 shows a continuum of results, with considerable variability between subgroups. In relation to the T-score mean (50), and in order from highest to lowest mean T-scores on the Similarities subtest, the results are as follows: 1) English-white-advantaged (means: 54.38 to 59.29) showed moderate to large-sized mean differences (4.38 to 9.29), with results indicating higher scores than the expected means; 2) Afrikaans-white-advantaged (means: 41.40 to 59.00) with a wide range of mean differences (0.25 to 10.00), with 12-, 14- and 15-year-olds within that subgroup scoring just below 50, and an isolated high mean for the 13-year-olds; 3) English-coloured-advantaged (means: 39.00 to 49.17), with mean differences ranging from 0.83 to

11.00 below the T-score mean (50); 4) English-coloured-disadvantaged (means: 42.77 to 46.27) with mean differences ranging from 3.73 to 7.23 lower than 50; 5) Afrikaans-coloured-advantaged (means: 31.25 to 49.75) with wide variability in mean differences, and 12- to 13-year-olds in this subgroup outperforming 14- and 15-year-olds; 6) Afrikaans-coloured-disadvantaged (means: 33.17 to 36.00) with large mean differences ranging from 14.00 to 19.31 in relation to the T-score mean of 50.

Once again, the findings shown in Table 85 resemble the trends shown in the WISC-IV Similarities subtest in the sample from the Eastern Cape (Shuttleworth-Edwards et al., in press). The continuum of performance in relation to the scaled score mean (10) in Shuttleworth-Edwards et al.'s study was as follows: 1) English-white-advantaged (mean scaled score = 14.08); 2) Afrikaans-white-advantaged (8.92); 3) Afrikaans-coloured-advantaged (7.44); and 4) Afrikaans-coloured-disadvantaged (4.33). These findings show inter-regional similarities of performance in Similarities subtests, and reinforce the necessity to use normative data that are stratified by language, race, and quality of education for this particular measure of verbal intelligence.

Table 86 also shows a continuum of results similar to the *t*-test comparisons for the other WASI subtests, in order from highest to lowest, as follows: 1) English-white-advantaged (means: 52.65 to 62.43) groups achieved scores higher than the T-score mean of 50 (mean differences: 2.00 to 12.43); 2) English-coloured-advantaged (means: 46.60 to 54.27; mean differences: 1.42 to 11.00; 3) Afrikaans-white-advantaged (mean: 43.60 to 54.25; mean differences: 3.20 to 4.25); 4) English-coloured-disadvantaged (means: 38.79 to 50.85; mean differences: 0.55 to 11.22); 5) Afrikaans-coloured-advantaged (means: 32.25 to 44.50; mean differences: 5.50 to 17.75); 6) and the lowest scores attained by the Afrikaans-coloured-disadvantaged group (means: 29.55 to 34.22; mean differences: 15.78 to 20.45) whose performances differed profoundly from normative indications suggested by the smoothed mean T-score of 50 for the WASI standardization sample.

As previously demonstrated for the other WASI subtests, the results between the Western Cape sample and Shuttleworth-Edwards et al.'s (in press) sample for the equivalent WISC-IV subtests demonstrate the same trends in performance according to sociodemographic profile, even though the stimulus items of the tests differ. The 12- to 13-year-olds from the Eastern Cape demonstrated a similar continuum of performance on the WISC-IV, in that the English-white-advantaged group achieved scaled scores above the mean of 10 (i.e., 13.75), and the other three groups (that are comparable to our study sample) all attained scaled score means below

10, in order, from highest to lowest, as follows: Afrikaans-white-advantaged (8.42); Afrikaans-coloured-advantaged (6.78); and Afrikaans-coloured-disadvantaged (3.17).

Table 86. *WASI Vocabulary Cross-Cultural Utility: Comparisons between local (study sample) norms and Psychological Corporation (1999) USA standardization norms*

USA Norms		Western Cape Norms*						T-test Statistics			
Age	**M (SD) [*n*]**	**Lang**	**Race**	**Q Ed**	***n***	**M**	**SD**	**Mean Diff**	***t***	***p***	***ESE***
12	50 (10) [100]	Afr	Col	Adv	3	41.33	15.31	-8.67	-0.98	.430	0.85
				Dis	30	31.13	6.76	-18.87	-15.29	**<.001**	2.00
			White	Adv	5	46.80	11.88	-3.20	-0.60	.580	0.32
		Eng	Col	Adv	11	54.27	10.21	4.27	1.39	.195	0.42
				Dis	18	38.79	9.25	-11.22	-5.15	**<.001**	1.13
			White	Adv	26	52.65	12.26	2.65	1.10	.280	0.25
13	50 (10) [100]	Afr	Col	Adv	4	44.50	10.02	-5.50	-1.10	.352	0.55
				Dis	13	30.92	7.47	-19.08	-9.21	**<.001**	1.94
			White	Adv	6	55.00	6.99	5.00	1.75	.140	0.50
		Eng	Col	Adv	10	48.30	7.69	-1.70	-0.70	.502	0.17
				Dis	13	39.62	9.19	-10.38	-4.08	**.002**	1.04
			White	Adv	19	57.63	9.70	2.00	0.95	.357	0.76
14	50 (10) [100]	Afr	Col	Adv	5	33.80	8.67	-16.20	-4.18	**.014**	1.62
				Dis	18	34.22	9.38	-15.78	-7.13	**<.001**	1.58
			White	Adv	5	43.60	13.87	-6.40	-1.03	.360	0.62
		Eng	Col	Adv	5	46.60	13.30	-11.00	-2.86	.598	0.33
				Dis	21	47.38	10.62	-2.62	-1.13	.272	0.26
			White	Adv	7	55.57	16.40	5.57	0.90	.403	0.53
15	50 (10) [100]	Afr	Col	Adv	4	32.25	7.93	-17.75	-4.48	**.021**	1.77
				Dis	29	29.55	9.60	-20.45	-11.47	**<.001**	2.05
			White	Adv	4	54.25	16.21	4.25	0.52	.636	0.41
		Eng	Col	Adv	12	52.58	6.29	1.42	1.42	.182	0.26
				Dis	11	50.55	9.95	0.55	0.18	.859	0.05
			White	Adv	7	62.43	7.66	12.43	4.30	**.005**	1.25

Note. Data are presented as T-scores; ESE = Hedges' *g* effect size estimate; *the sample (N = 286) included female and male participants; Col = coloured; Q Ed = Quality of Education.

Overall findings related to the Wechsler verbal subscales demonstrate particularly pronounced higher scores for English-speakers relative to Afrikaans-speakers, and further reinforce the necessity to conduct future studies designed specifically to evaluate the impact of detailed linguistic aspects on cognitive test performance.

3.1.11.3. WASI IQ scores

The overall findings presented above illustrate that for all four WASI subtests, the use of the original age-adjusted standardization norms could be considered to be appropriate for English-speaking, white participants with advantaged quality of education, and with a degree of interpretive caution, for English-speaking, coloured participants with advantaged quality of education, and Afrikaans-speaking, white participants with advantaged quality of education. However, the use of the original norms was highly questionable for Afrikaans-speaking, coloured participants with advantaged quality of education, and markedly inappropriate for Afrikaans- and English-speaking, coloured participants with disadvantaged quality of education, and Afrikaans-speaking, coloured participants with disadvantaged quality of education.

When conducting individual assessments, clinicians often evaluate the functioning of discrete cognitive domains in relation to achievement on a measure of general intellectual functioning, such as the WASI IQ score (Lezak et al., 2004; Strauss et al., 2006; Wechsler, 2004). As there are no South African norms for the WASI, clinicians tend to use the original norms. Because other inferences are made in relation to the IQ score, the use of inaccurate norms for subtests comprising the composite IQ scores holds the potential for negative ripple effects. To illustrate just how dangerous improper inference based on the use of the non-local norms might be, I compared the WASI full scale IQ scores that were derived from the standardization norms to the FSIQ scores derived from the norms created in this study.

Table 87.*WASI Full Scale IQ Scores: Interpretive Ranges*

	Percentage of Scores Within Each Interpretive Category			
Interpretive Category	**Theoretical Normal Curve**	**WASI Standardization Sample (*n* = 2245)**	**Study Sample using WASI Norms (*n* = 286)**	**Study Sample using Local Norms (*n* = 286)**
Very Superior	2.2	2.0	1.1	2.4
Superior	6.7	7.3	2.8	4.5
High Average	16.1	15.6	1.1	16.2
Average	50.0	50.0	39.0	51.4
Low Average	16.1	15.8	23.3	16.2
Borderline	6.7	6.8	20.9	6.9
Extremely Low	2.2	2.5	11.8	2.4

Note. The table was based on Table 5.19 in the WASI manual (Psychological Corporation, 1999, p. 136).

Table 87 demonstrates the percentages of scores that fall within each FSIQ interpretive category in relation to expectations based on the theoretical standard normal distribution. When the WASI norms were used to calculate FSIQ scores of our sample, the range of expected scores differed significantly from the actual scores. In contrast, when the demographically adjusted norms from this study are used, the FSIQ scores for the study sample are compatible with theoretical expectations, and with the distribution of scores demonstrated in the WASI standardization sample.

3.1.12. WISC-IV UK Edition Coding Subtest (Coding)

3.1.12.1. Coding: Relative influences of sociodemographic factors and stratified norms

The results of the ANCOVA (Table 88) show that younger age, male sex, and disadvantaged quality of education predicted poorer performance on information processing speed, as measured by the WISC-IV Coding subtest. Age contributed the highest portion of variance (16.2%), when the effects of the other sociodemographic variables were held constant. Relative to age, quality of education and sex contributed less to the variance in performance (5.5% and 2.7%, respectively).

Table 88. *Coding Analyses of Covariance: Effects of age, sex, language, and quality of education*

	F	p	ω^2
Main Effect			
Age	39.95	**<.001**	.162
Sex	5.71	**.018**	.027
Language	1.78	.183	.009
Quality of Education	11.92	**.001**	.055
Interaction Effect			
Sex x Language	2.97	.086	.014
Sex x Quality of Education	1.99	.160	.010
Language x Quality of Education	3.58	.060	.017
Sex x Language x Quality of Education	1.32	.253	.006

Again, due to reasons explained earlier, the effects of race were investigated within the advantaged group only. Table 89 shows that there were no statistically significant differences in Coding scores between coloured and white participants within the group with advantaged quality of education. Hence, there was no need for separate ANCOVAs including race as a covariate.

Table 89. *Coding Analyses of Variance: Between-race comparisons for participants with advantaged quality of education*

Outcome Measure	Race						ANOVA Test Statistics	
	Coloured			White				
	n	*M*	*SD*	*n*	*M*	*SD*	*F*	*p*
Coding	27	53.96	11.02	67	55.42	12.28	0.29	.594

Note. Data are presented as raw scores.

Because age was significantly associated with performance on Coding (see Table 88), it was necessary to determine how to cluster age-groups for the normative data. Although the means plot (Figure 13) demonstrates a linear trend of gradual improvement between the ages of 12 and 15, the LSD tests (Table 90) demonstrated that the differences between 12- and 13-year-olds were non-significant. Similarly, differences between 14- and 15-year-olds were not significant. I therefore stratified the normative data by two age-groups (12 to 13 years; and 14 to 15 years).

Table 90. *Coding Post-hoc LSD Analyses: Mean differences for age-group comparisons*

	Mean Difference	*p*
12 vs 13	-3.43	.123
12 vs 14	-7.09	**.001**
12 vs 15	-9.54	**<.001**
13 vs 14	-3.66	.121
13 vs 15	-6.11	**.008**
14 vs 15	-2.45	.268

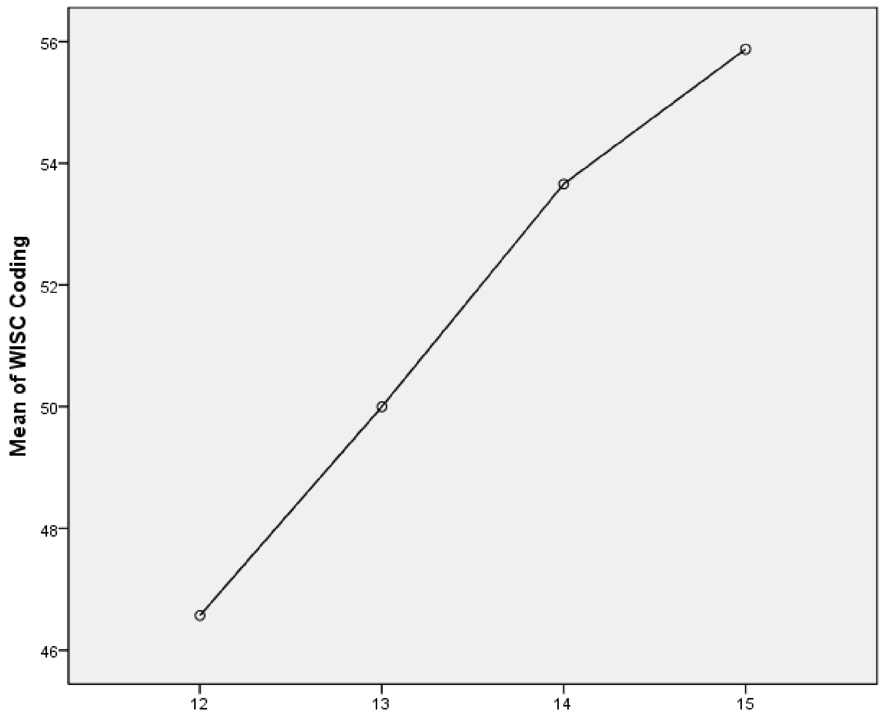

Figure 13. Coding raw score means plot by age-group (raw scores).

As a result of the abovementioned findings, descriptive normative data for Coding were stratified by two age-groups, sex, and quality of education (see Table 91). The corresponding normative conversion tables for Coding are presented in Appendix D (Tables D-138 to D-145).

Table 91. *Coding Descriptive Normative Data: Stratified by age, sex, and quality of education*

Age	**Sex**	**Quality of Education**	***n***	***M***	***SD***	**Range**
12 to 13	Female	Advantaged	30	54.67	9.36	33 – 76
		Disadvantaged	31	46.35	7.63	32 – 61
	Male	Advantaged	27	48.52	9.67	29 – 70
		Disadvantaged	21	40.00	8.61	24 – 57
14 to 15	Female	Advantaged	21	62.00	12.49	37 – 92
		Disadvantaged	35	55.43	9.71	38 – 77
	Male	Advantaged	16	57.37	13.68	28 – 80
		Disadvantaged	34	48.59	12.32	26 - 82

Note. Data are presented as raw scores; the sample (N = 215) included Afrikaans- and English-speaking participants; groups with advantaged quality of education included coloured and white participants; groups with disadvantaged quality of education included coloured participants.

The data in Table 91 show that age-related improvements occurred within the subgroups (sex and quality of education). For example, Coding scores for female-advantaged 14-to 15-year-olds were higher (mean difference: 7.33) than for female-advantaged 12- to 13-year-olds. Similar increments between the age-groups were demonstrated for the other subgroups (female-disadvantaged by 9.08; male-advantaged by 8.85; and male-disadvantaged by 8.59 points). Within each age-group, highest performances were demonstrated by female-advantaged, then male-advantaged, followed by female-disadvantaged, and with the lowest scores attained by the male-disadvantaged groups.

The trend of gradual improvement with age is consistent with findings from the WISC-IV standardization study, that demonstrated gradual increments in Coding ability throughout childhood and adolescence (Wechsler, 2004). Our findings of a female advantage in Coding is consistent with Cockroft and Blackburn's (2008) findings that 8-year-old girls attained higher scores on the SSAIS-R Coding subtest (which is similar to the WISC-IV version).

3.1.12.2. Coding: Cross-cultural comparison of norms

In order to investigate the cross-cultural utility of the Western Cape Coding norms derived from the current data, I compared those data with two sets of non-local norms: 1) those derived from Wechsler's (2004) UK standardization sample; and 2) those derived from Shuttleworth-Edwards et al.'s (in press) study. I conducted the second set of t-test comparisons to evaluate the inter-regional compatibility of the normative data collected for exactly the same instrument on a sociodemographically similar sample of 12- to 13-year-olds from the Eastern Cape.

For the first set of comparisons (see Table 92) I used the age-group divisions that were used in the manual, and I stratified each age-group by sex and quality of education as well. For the second set of comparisons (see Table 93), I only used data that matched the profile of the Eastern Cape sample (i.e., 12- to 13-year-old, English-white-advantaged; Afrikaans-white-advantaged; Afrikaans-coloured-advantaged; and Afrikaans-coloured-disadvantaged groups). To facilitate direct comparisons of data using the same unit of measurement, I transformed the raw Coding scores to scaled scores using the UK standardization conversion tables.

Table 92. *Coding Cross-Cultural Utility: Comparisons between local (study sample) norms and Wechsler's (2004) WISC-IV UK standardization norms*

Wechsler (2004) WISC-IV UK Standardization Norms				**Western Cape Norms***					**T-test Statistics**			
Age	***n***	***M***	***SD***	**Sex**	**Q Ed**	***n***	***M***	***SD***	**Mean Diff**	***t***	***p***	***ESE***
12 to 13	136	10.6	2.4	Female	Adv	30	9.73	2.57	-0.87	-1.85	.075	0.36
					Dis	31	7.39	1.98	-3.21	-9.05	**<.001**	1.37
				Male	Adv	27	7.93	2.53	-2.67	-5.50	**<.001**	1.10
					Dis	21	5.86	2.37	-4.74	-9.16	**<.001**	1.97
14 to 15	135	10.1	2.9	Female	Adv	21	8.95	3.11	-1.15	-1.69	.106	0.39
					Dis	35	7.66	2.30	-2.44	-6.28	**<.001**	0.87
				Male	Adv	16	8.13	3.10	-1.98	-2.55	**.022**	0.67
					Dis	34	5.91	2.78	-4.19	-8.79	**<.001**	1.45

Note. Data are presented as scaled scores; ESE = Hedges' *g* effect size estimate; *the sample ($N = 215$) included Afrikaans- and English-speaking participants; Q Ed = Quality of Education; Adv = groups with advantaged quality of education, which included coloured and white participants; Dis = groups with disadvantaged quality of education, which included coloured participants.

The results of the comparisons between local norms and the UK standardization norms shown in Table 92 show that for female-advantaged groups, the mean differences between scaled scores were not statistically or clinically significant. This implies that the non-local norms are appropriate for use in 12- to 15-year-old Afrikaans- and English-speaking, female participants, with advantaged quality of education.

For the other local subgroups, however, the results demonstrated that the use of the standardization norms is contraindicated. For the male-advantaged groups, the mean differences were statistically significant, and clinically significant (> 1 SD). Effect sizes were larger for the

12- to 13-year-olds than for the 14- to 15-year-olds for this particular group. For female-disadvantaged groups, the mean differences between the local and WISC-IV norms were statistically significant for both age groups, with large effect sizes. The mean differences were not clinically significant for the 14- to 15-year-olds, but did exceed one SD for the 12- to 13-year-olds. The most profound differences between local and UK norms were exhibited in the male-disadvantaged group, where for both age-groups, mean differences were statistically and clinically significant (approaching 2 scaled score SDs) with large effect sizes. These results underscore the importance of using local normative data for all but one of the aforementioned subjects, in order to minimize the risk of false positive diagnoses of impaired processing speed for participants matching the sociodemographic profile of the study.

Table 93. *Coding Cross-Cultural Utility: Comparisons between local (study sample) norms and Shuttleworth-Edwards et al.'s (in press)Eastern Cape Norms*

Shuttleworth-Edwards et al. (in press) Eastern Cape Norms for 12- to 13-year-olds						**Western Cape Norms***			**T-test Statistics**			
n	***M***	***SD***	**Lang**	**Race**	**Q Ed**	***n***	***M***	***SD***	**Mean Diff**	***t***	***p***	***ESE***
12	8.00	2.66	Eng	White	Adv	43	9.35	2.43	1.35	3.64	**.001**	0.54
12	8.33	2.77	Afr	White	Adv	5	6.60	2.19	-1.73	-1.76	.152	0.62
9	6.00	1.23	Afr	Col	Adv	6	6.83	1.30	0.83	1.02	.989	0.29
12	6.00	1.95	Afr	Col	Dis	44	6.93	2.69	0.93	2.30	**.026**	0.36

Note. Data are presented as scaled scores; ESE = Hedges' *g* effect size estimate; *the sample (*N* = 98) included female and male participants; Lang = Language; Eng = English; Afr = Afrikaans; Col = Coloured participants; Q Ed = Quality of Education; Adv = advantaged quality of education; Dis = disadvantaged quality of education.

The results of the t-test comparisons between the Western Cape and Eastern Cape norms showed that performances were similar across South African regions. For the Afrikaans-coloured-advantaged, and Afrikaans-white-advantaged groups, scaled scores were not statistically or clinically significant (< 1 Eastern Cape SD). For the English-white-advantaged group, Western Cape participants achieved slightly higher scaled scores than the Eastern Cape sample. Although the mean difference was statistically significant, it did not exceed one SD, therefore can not be regarded as clinically meaningful. For the Afrikaans-coloured-disadvantaged group, the mean difference was also statistically significant, but it did not exceed one SD, therefore was not clinically significant. The similarities in data yielded from this inter-regional cross-cultural comparison imply that for the WISC-IV Coding subtest, the two sets of norms could be used interchangeably, within the specific constraints of the sociodemographic profiles described. The two sets of comparisons illustrate that, for this particular cognitive test, inter-regional South African norms may be preferable to non-African standardization norms.

3.2. Relationships between sociodemographic factors and cognitive domains

The importance of ascertaining the relative contributions of all the sociodemographic variables on all of the cognitive outcome measures cannot be overstated. Knowing precisely which outcome variables were affected by which particular independent variables, and to what extent, allowed me to stratify the normative data for each measure, according to the results of the multiple analyses. The preceding section provided extensive details regarding the minutiae of the data.

In the following section, I provide a broad overview of the data. In order to reduce the data derived from multiple measures of cognitive functioning, I clustered the scores together in composite cognitive domains. This facilitated an overall perspective of the relationships between cognitive functioning and each of the sociodemographic factors that have been the focus of this study (i.e., age, sex, language, quality of education, and race).

3.2.1. Composite cognitive domain measures

In order to reduce cognitive test data into composite measures, I clustered the measures together on theoretical grounds, guided by the descriptions provided in key neuropsychological texts (Lezak et al., 2004; Mitrushina et al., 2005; Strauss et al., 2006), test manuals, and key journal articles related to each instrument. I then transformed all raw scores to z-scores, and tested how well the measures in each domain were correlated in practice. Ten composite neuropsychological domain scores, with Cronbach's alpha coefficients ranging from .50 to .96, were created.

The 10 domains were labeled: Intelligence; Simple Attention; Fine Motor Coordination; Visuospatial Ability; Verbal Memory; Visual Memory; and four elements of Executive Functioning (i.e., Attentional Control; Information Processing; Cognitive Flexibility; and Goal Setting), following the model defined by P. Anderson et al. (2001). Table 94 shows the alpha coefficients, the descriptive statistics (presented as z-scores), and the specific measures that were included in each domain score. Three of the domain scores (Simple Attention, Visual Memory, and Attentional Control) each only consist of one measure, so strictly speaking, should be regarded as *representative* rather than *composite* measures of the cognitive domains. The other seven composite domain scores were comprised of two to six cognitive outcome measures.

Table 94. *Composite Cognitive Domain Scores*

Domain	Cognitive Outcome Measures	*α*	*N*	*M*	*SD*	*Range*
Intelligence (*g*)	Wechsler Abbreviated Scale of Intelligence: Full Scale IQ; Short Form IQ	.96	287	0.00	0.98	-2.47 to 3.54
Simple Attention	Children's Memory Scales: Numbers Forward Subtest	N/A	216	0.00	1.00	-3.53 to 2.38
Fine Motor Coordination	Grooved Pegboard Test 1: Dominant and Nondominant Hand Peg Insertion Times (reverse scored)	.64	216	0.00	0.86	-4.09 to 2.02
Visuospatial Ability	Wechsler Abbreviated Scale of Intelligence Block Design Subtest T-score; CLOX Test Trial 2; Rey-Osterrieth Complex Figure Test Copy Accuracy	.50	216	0.05	2.05	-7.43 to 4.71
Verbal Memory	Maj's Auditory Verbal Learning Test (WHO/UCLA version): Trial 1; Immediate Recall; Delayed Recall; and Recognition	.74	216	0.00	2.99	-7.66 to 6.49
Visual Memory	Rey-Osterrieth Complex Figure Test: Immediate and Delayed Recall	N/A	216	0.01	1.99	-5.17 to 5.43
Executive Functioning:						
Attentional Control	Children's Color Trails Test Trial 1 (reverse scored)	N/A	216	0.00	1.00	-3.70 to 1.99
Information Processing Speed	Wechsler Intelligence Scale for Children (4th UK edition) Coding Subtest; Grooved Pegboard Test 2: Peg Removal Dominant and Nondominant Hand (reverse scored); Rey-Osterrieth Complex Figure Test Copy Completion Time (reverse scored); Tower of London Total Problem-solving Time (reverse scored)	.63	216	0.00	3.17	-14.61 to 7.85
Cognitive Flexibility	Children's Memory Scales Numbers Backward Subtest; Children's Color Trails Test Trial 2 (reverse scored); Phonemic Fluency (Total for Letters L, B, and S); Semantic Fluency (Animal Category); Stroop Color-Word Test Color-Word Page Total Correct; Error Total (MAVLT repetitions and insertions; Tower of London rule violations; Verbal Fluency repetitions, set loss errors and rule violations)	.71	216	0.03	3.88	-7.39 to 17.88
Goal Setting	Tower of London Total Correct Score	N/A	216	0.00	1.00	-2.24 to 3.35

Note. Outcome measure data are presented as *z*-scores.

Because cognitive measures are often multimodal, and because multiple measures for each domain are available, there are many options for creating and interpreting composite scores. The methodology used in this study is merely one example of how to reduce multiple data for interpretive purposes. The particular domain scores in this study are thus context specific, in that they represent the best combinations of cognitive measures for this particular data set. For other studies, other constellations of cognitive outcome measures may be more appropriate.

3.2.2. Principal component analyses

The purpose of the PCAs was to reduce data to detect trends in performance and to demonstrate the relationships between sociodemographic factors and cognitive domain scores. The strength of PCA is that it graphically represents the gist of multiple findings. Conversely, because it is a reductionist technique, it also results in lost information. Table 95 and Figure 14 show that two variables were not well represented in the model (i.e., the percentage of variance would not have been adequately reflected on the scatter plots). Because only 58% of the variance in Goal Setting and 51% in Simple Attention would have been represented on the PCA biplots, these two variables were excluded from the scatter plots. The other eight cognitive domains were included in the scatter plots because the variance for these scores was adequately represented in the biplots (R^2 = .69 - .81).

Table 95. *Suitability of Cognitive Domain Scores for the Principal Component Model*

Cognitive Domain Variable Number	Domain Score	R^2
18	Cognitive Flexibility	0.81
16	Attentional Control	0.80
17	Information Processing	0.79
15	Visual Memory	0.78
13	Visuospatial Ability	0.78
10	Intelligence	0.74
12	Fine Motor Coordination	0.71
14	Verbal Memory	0.69
19	Goal Setting	0.58
11	Simple Attention	0.51

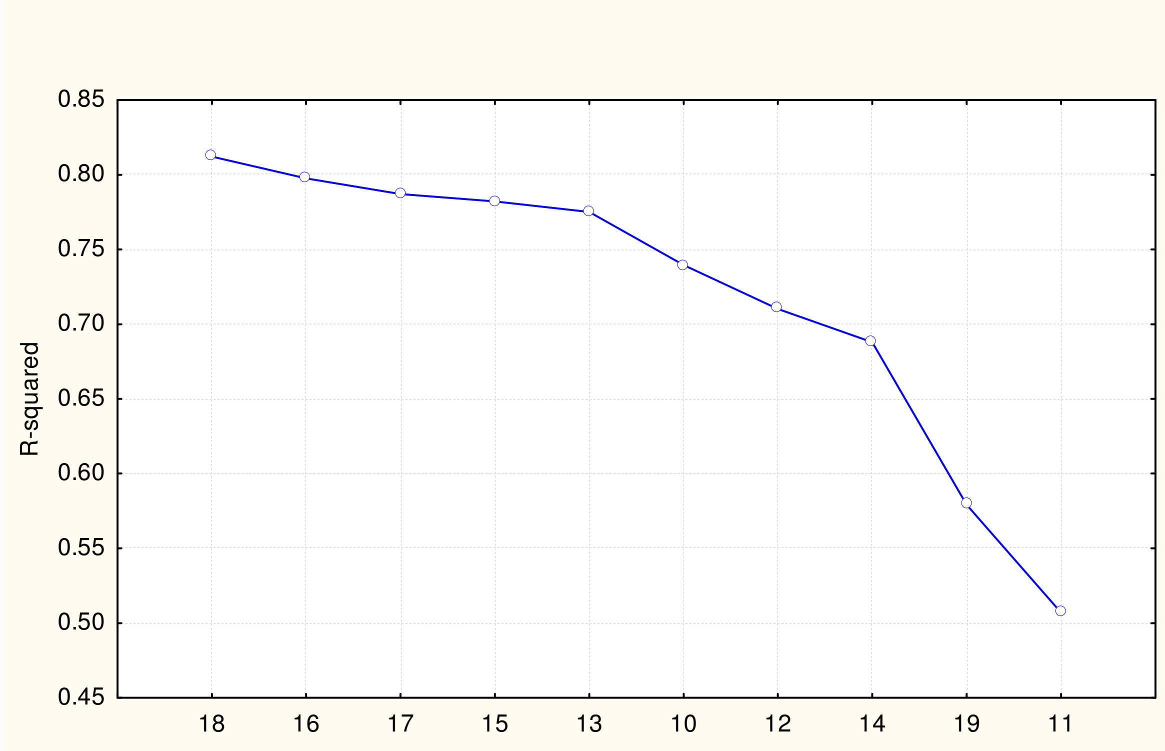

Figure 14. Line plot of correlation coefficients against cognitive domains, demonstrating the suitability of cognitive domain scores for the principal component model,

3.2.2.1. Interpretation of principal component analysis graphs

Because principal component analyses are infrequently reported in normative studies, I have included some explanatory notes.

- **Arrows**: The scores clustered towards the arrow heads indicate better performance in those particular domains, regardless of the direction of the arrows.
- **Domain positions**: If the domains are positioned closely together (either at the top, bottom, or right side of the graph), it indicates that they are correlated. The relative proximity of the arrow heads indicate how closely they are correlated (i.e., the domains represented by arrows that are positioned close to each other indicate that they are highly correlated). The domains positioned at the opposite ends (i.e., the top and bottom) of the graph are not correlated with one another.
- **Alpha (linear) bags**: The linear bags, called *alpha bags,* represent 90% confidence levels. Scores falling outside of the bags represent individual performances that deviate from the general trends. The shape of the alpha bag demonstrates the variability in scores and directional indicators. For example, smaller bags indicate less variability in scores; bags that "pull" towards the arrow heads indicate stronger associations between the dimension under investigation (e.g., sex) and performance in cognitive domains.

3.2.2.2. Relationships between cognitive domains

The scatter plots (see Figures 15 to 19) yielded from the PCAs suggested that certain domains were more strongly related to each other than others. Information Processing, Fine Motor Coordination and Attentional Control (located at the top axes of the graphs) were highly correlated with each other. The correlations between these measures are probably attributable to the fact that they are all timed measures. Verbal Memory, Visuospatial Ability, and Intelligence (located on the *x* axes) were correlated with each other, but not related to the timed measures. Visual Memory was moderately correlated with Intelligence, Visuospatial Ability, and Verbal Memory. Cognitive Flexibility was not strongly related to the other domains. Two of the elements of Executive Functioning were strongly related to each other (Attentional Control and Information Processing) but not to Cognitive Flexibility. Executive Functioning and Intelligence measures were not correlated.

The variability between the different elements of Executive Functioning is not unusual or unexpected, and supports previous recommendations that it is probably inadvisable to measure Executive Functioning as a unitary construct (P. Anderson, 2002; P. Anderson, Anderson, & Garth, 2001; V. Anderson, 1998). The three measures of Goal Setting (i.e., the 1st trial of the CLOX test, the Total Correct Score from the Tower of London, and the Organizational Strategy Score from the Rey-Osterrieth Complex Figure Test) were weakly associated (α = .36). As the Goal Setting domain score was excluded from the scatter plots of the principal component analyses, it was not possible to ascertain whether the Goal Setting domain was related to the other Executive Functioning domains. Two of Anderson's four elements (Attentional Control and Information Processing) were very closely related. For this sample, they could have been measured as one domain. Cognitive Flexibility, however, was weakly associated with Attentional Control and Information Processing, indicating the necessity to assess this aspect of Executive Functioning separately.

Previous literature has demonstrated strong associations between Intelligence and Executive Functioning (e.g., Arffa, 2007; De Luca et al., 2003; Zook, Davalos, Delosh, & Davis, 2004). The findings of this study are, therefore, unusual in that regard. The weak relationships between the two cognitive domains observed in this population may be attributable to the complexities associated with the WASI as a measure of intelligence. It is possible that for participants with disadvantaged quality of education, for example, the WASI does not provide a fair representation of intellectual abilities. Further studies would be useful to investigate other measures of both Intelligence and Executive Functioning in the study population, to establish which instruments are most strongly correlated.

As previously described, opinions differ regarding how to interpret IQ scores. Opponents of intelligence testing argue that IQ scores are misleading and lack clinical utility, and prefer measures of executive functioning in collaboration with detailed-history-taking to gauge patient's premorbid functioning and current adaptive functioning (Lezak et al., 2004). On the other hand, others argue that IQ scores provide clinically useful estimates of premorbid functioning, and attest to the ecological validity of IQ scores in terms of predicting educational and employment outcomes. Such proponents consider intelligence testing to be an essential component of cognitive assessments, and interpret other cognitive outcome scores in relation to IQ scores (Hiscock, 2007; Mitrushina et al., 2005).

In practice, proponents of the IQ score would *control* for IQ in various ways. In normative research, for example, the effects of IQ on other psychometric scores have been controlled by stratifying normative data by IQ. For example, Steinberg et al. (2005) demonstrated that age-adjusted WAIS-R Full Scale IQ was more strongly associated with TMT and COWAT scores than level of education. As a result of these findings, they stratified norms for the TMT and the COWAT by age-group and by seven IQ ranges. For these measures, in the specified population, clinicians would therefore control for IQ by using the IQ-adjusted norms.

Mitrushina et al. (2005) point out that IQ-adjusted norms are rare, and appeal to authors to report IQ scores in studies of other cognitive measures so that future meta-analytic studies can include IQ-adjusted data. Although Mitrushina and colleagues derived mathematical equations to control for the effects of other sociodemographic effects, such as age, and level of education, precise information regarding exactly how to adjust scores for participants outside the IQ range of the meta-analytic study samples is not available. In clinical practice, such score adjustments are sometimes necessary (Hemp, 2010), but it is unclear how the clinicians ascertain the precise magnitude of the adjustments.

In this study, the PCA findings regarding the relationships between Intelligence and other domains provide an indication of which domains would warrant control for IQ, and which would not. In this sample, it would be useful to control for Intelligence when interpreting Visuospatial Ability, and to a slightly less extent, Verbal and Visual Memory. However, it would be relatively meaningless to control for Intelligence when assessing Cognitive

Flexibility, and completely unnecessary to control for Intelligence when interpreting Information Processing, Fine Motor Coordination, and Attentional Control. However, further analyses would be necessary to provide specific recommendations regarding the amount of adjustment needed to control for IQ in the measures of Visuospatial Ability and Memory.

3.2.2.3. Relationships between sex and cognitive domains

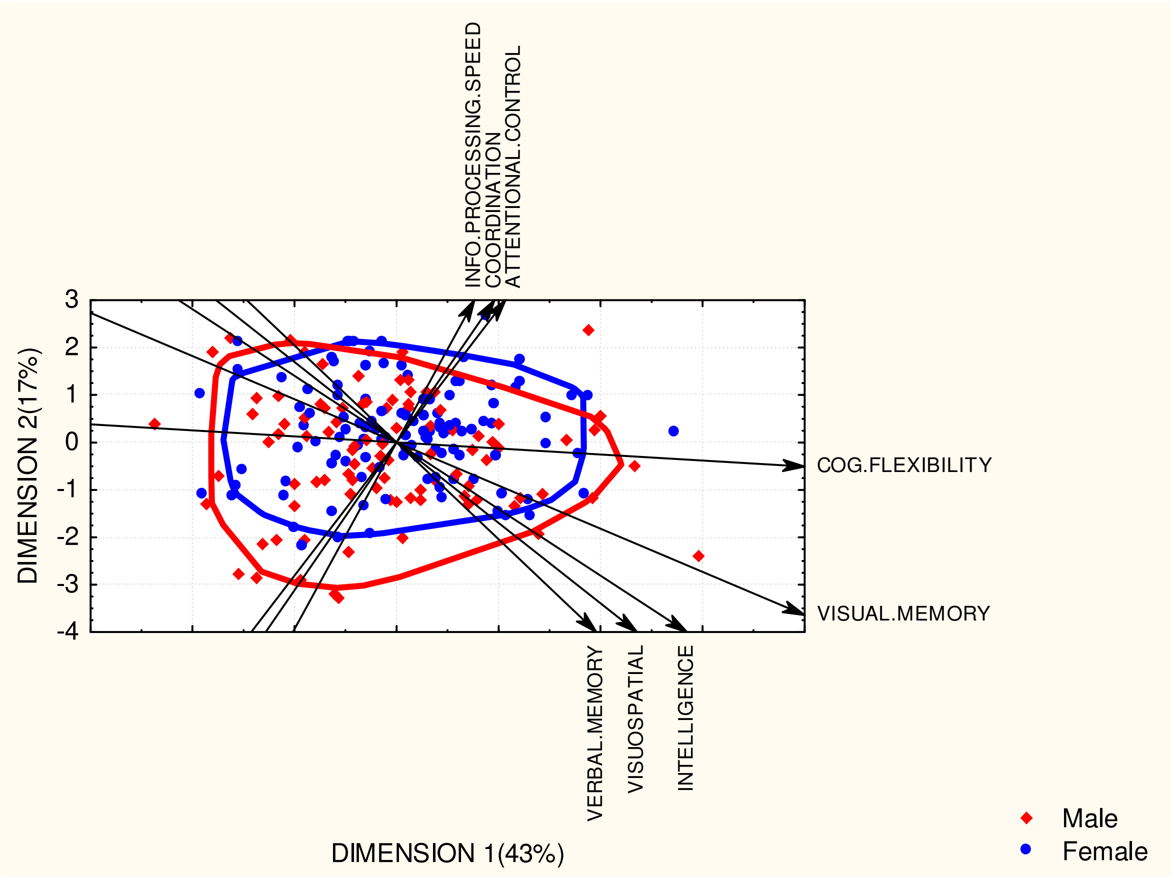

Figure 15. Scatter plot of cognitive domains against sex.

Overall, Figure 15 demonstrates very little variability between males and females in the pattern of cognitive performance. The Alpha bags show that more males than females tended to perform at the lower end of the score ranges for the domains of Information Processing, Coordination, and Attentional Control. In contrast, more males than females performed at the upper end of the score ranges for Cognitive Flexibility.

3.2.2.4. Relationships between language and cognitive domains

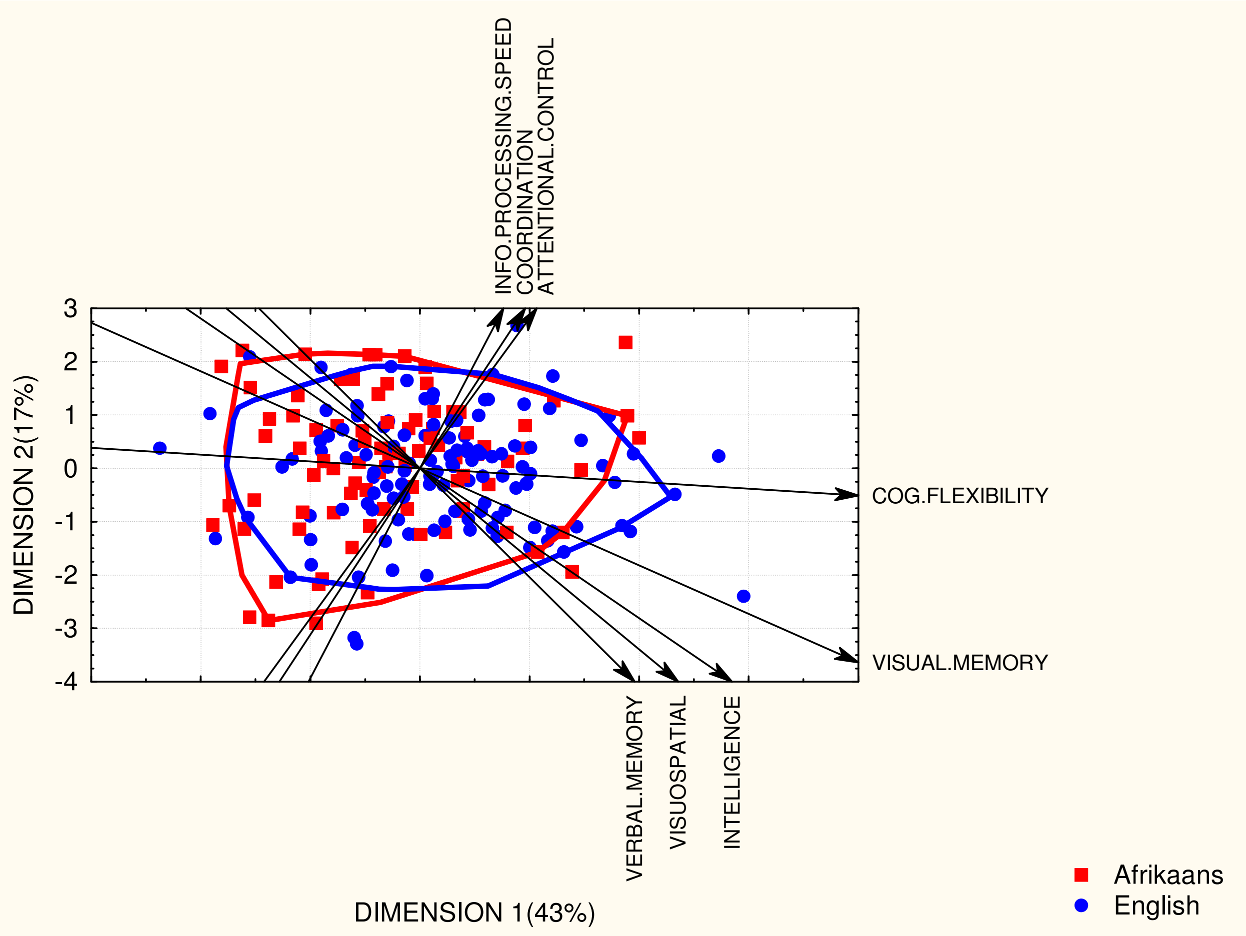

Figure 16. Scatter plot of cognitive domains against language.

The scatter plot in Figure 16 demonstrates that there was very little overall variation in cognitive performance between the two language groups. There appeared to be marginally more Afrikaans-speakers who performed at the lower range for Attentional Control and Intelligence domains. Slightly more English-speakers performed at the higher end of the range for Cognitive Flexibility. These findings may indicate that, apart from the measures identified in the individual test analyses as problematic, the majority of the tests in the compendium appeared to be linguistically fair for English- and Afrikaans-speaking adolescents.

3.2.2.5. Relationships between quality of education and cognitive domains

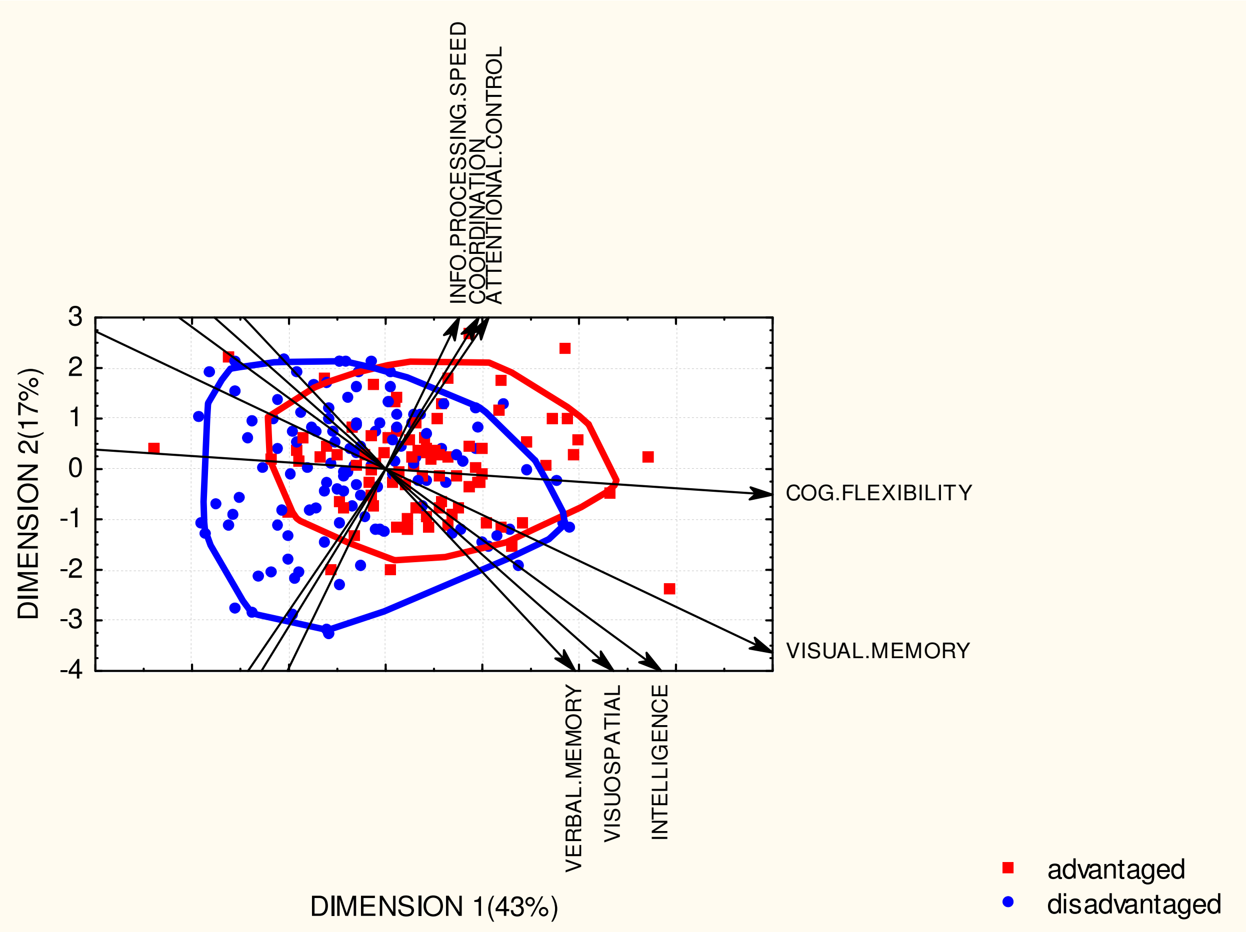

Figure 17. Scatter plot of cognitive domains against quality of education.

The large discrepancies in performance between adolescents with differing quality of education that were demonstrated in the analyses of covariance were reinforced in the principal component analyses (see Figure 17). Adolescents with disadvantaged quality of education exhibited more variability in performance than those with advantaged quality of education. In all cases, the variability was at the lower end of the score spectra. In other words, more disadvantaged children performed at the lower score ranges in all eight cognitive domains. Participants with advantaged quality of education demonstrated higher ceilings of performance in half of the cognitive domains. Fewer high-end scores were exhibited by those with disadvantaged quality of education in the domains of Information Processing, Coordination, and Attentional Control. Participants with advantaged quality of education exhibited fewer low scores and more high scores than the disadvantaged group in Information Processing, Speed, Coordination, Attentional Control, and Cognitive Flexibility.

The discrepancies in performance between participants with advantaged and disadvantaged quality of education correspond with previous literature from North America (e.g., Manly, 2006; Manly et al., 2004; Manly & Echemendia, 2007; Manly, Jacobs, Touradji, Small, & Stern, 2002), and South Africa (e.g., Cavé & Grieve, 2009; Grieve & van Eeden, 2010; Shuttleworth-Edwards, Kemp et al., 2004; Shuttleworth-Edwards et al., in press), and powerfully reinforce the necessity for separately stratified normative data for participants with differing quality of education.

3.2.2.6. Relationships between race (for participants with advantaged quality of education) and cognitive domains

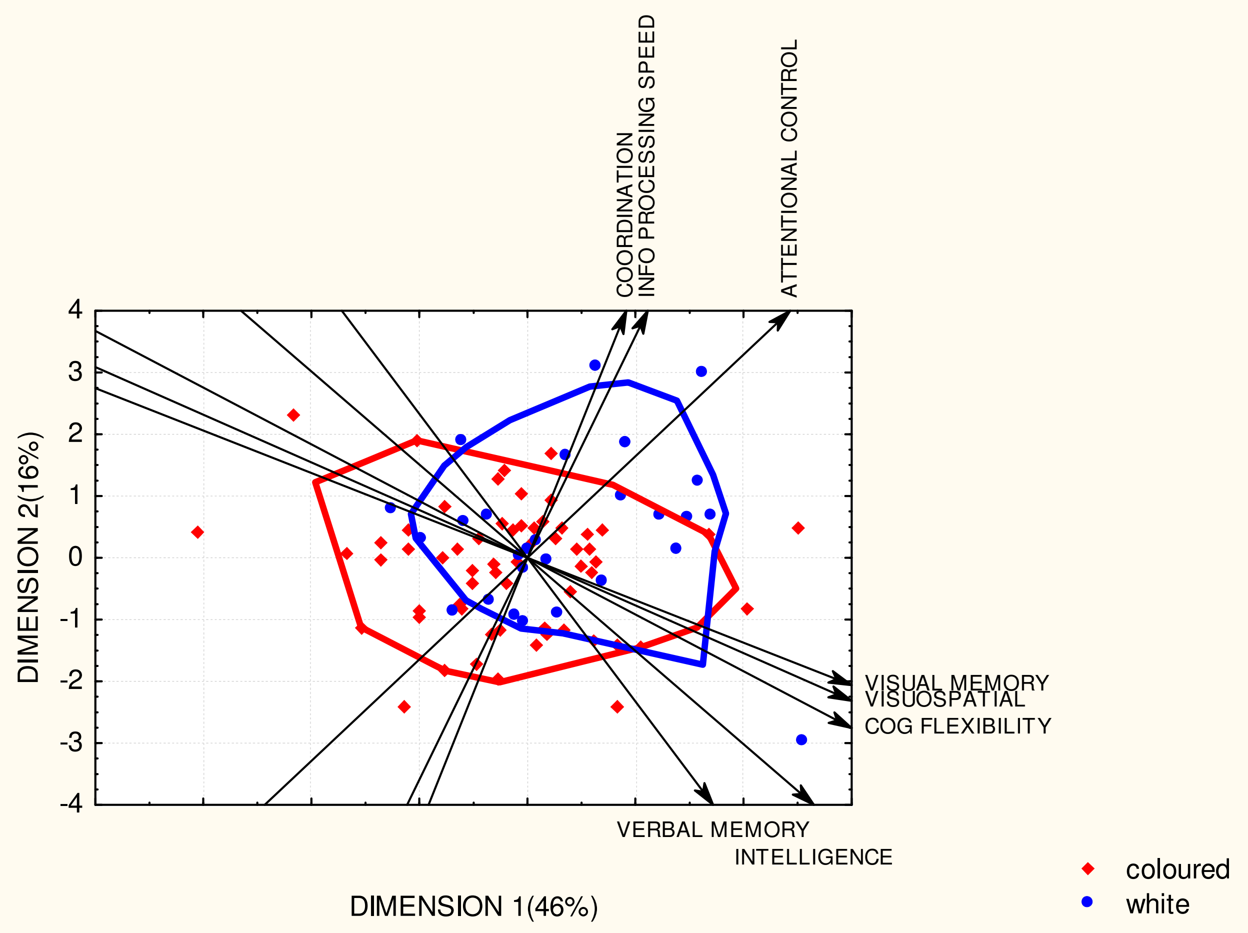

Figure 18. Scatter plot of cognitive domains against race (for participants with advantaged quality of education).

Due to the fact that there were no white participants with disadvantaged quality of education, I only investigated the relationships between race and cognitive domains within the groups with advantaged quality of education, which included coloured and white participants. The PCA biplot (Figure 18) shows that race was not uniformly related to all cognitive domains. The range of scores for Verbal Memory were very similar for coloured and white participants, possibly due to the lack of cultural bias demonstrated in the MAVLT measure. However, due to the exclusion of the CMS Stories subtest from analyses due to reasons described previously, it would be useful to investigate whether there are racial differences in verbal measures that embed the information within a semantic context.

Four domains appeared to be associated with race only at the lower end of the spectra. For the domains of Visual Memory, Visuospatial Ability, Cognitive Flexibility, and Intelligence, the alpha bags showed lower floors for the coloured group, in comparison to the white group, but similar ceilings. In other words, equivalent numbers of coloured and white participants appeared to achieve high-end scores in those domains, but the coloured group demonstrated a wider range of scores at the lower end of the spectra than the white group.

The implications of these findings for Intelligence, for example, would differ according to the purpose of the cognitive assessment. For example, if Intelligence was measured for scholastic placements into top-end academic streams, coloured and white participants would have similar chances of selection. However, if, for example, Intelligence was used in a neuropsychological assessment as a proxy for pre-morbid functioning in the case of brain injury, clinicians could fail to detect real pathology if lowered scores in other domains were assumed to be related to lower pre-morbid intellectual functioning.

Of all the domains, those measured with timed tasks, namely, Coordination, Information Processing Speed, and Attentional Control, exhibited the widest degree of variability in performance between coloured and white participants with advantaged quality of education. The alpha bags show a lower floor and lower ceiling for the coloured group, compared to the white group. The implications of these findings are that speeded tasks appear to exhibit a strong degree of racial bias against coloured participants. Again, this reinforces the necessity to use racially stratified norms when interpreting the results of timed cognitive measures for coloured participants.

3.2.2.7. Relationships between age and cognitive domains

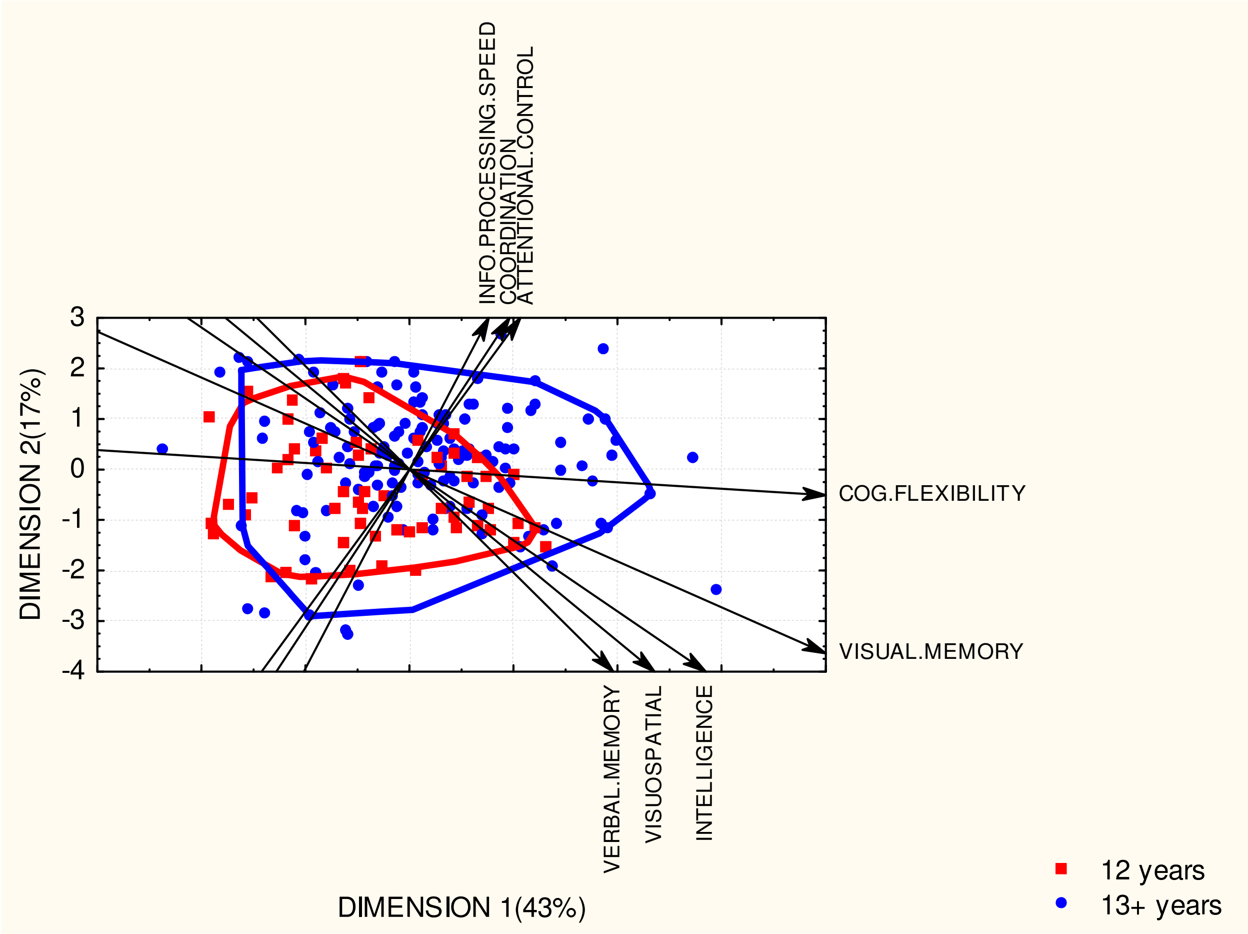

Figure 19. Scatter plot of cognitive domains against age-group.

In the other analyses of age related data (i.e., analyses of covariance, post-hoc LSD analyses and age plots), the overall trends demonstrated that the majority of achievement differences were between the 12-year old group and the 13- to 15-year-old group. I thus used this particular configuration for the principal component analyses.

The overall age-related patterns in Figure 19 show that there was more variability in performance in older adolescents, in comparison with 12-year-olds. The younger participants exhibited a more restricted range of performance. The 13- to 15-year old group achieved a much wider range of higher performances in Information Processing, Coordination, Attentional Control and Cognitive Flexibility. Very few age-related differences seemed to be evident in the domains of Memory (Visual and Verbal) and Visuospatial Ability.

The developmental step between the ages of 12 and 13, and the expanded range of performances in the older adolescents seem to be in accordance with the biological maturation processes reported during the adolescent phase. Specifically, this study showed age-related increments in the domains of Information Processing, Coordination, Attentional control and Cognitive Flexibility, whereas the domains of Memory and Visuospatial Ability seemed to remain relatively stable between the ages of 12 and 15.

These findings appear to replicate other findings that particular aspects of Executive Functioning (in this case, Information Processing, Attentional Control and Cognitive Flexibility) continue to develop during adolescence (P. Anderson, 2002; P. Anderson, Anderson, & Garth, 2001; V. A. Anderson, Anderson, Northam et al., 2001; Dennis, 2006; Dennis et al., 1991). These findings imply that the biological maturation processes reported in studies of the adolescent brain may contribute towards the improvements in speed and efficiency of performance exhibited in our adolescent sample (Giedd et al., 2008; Gogtay et al., 2004; Luna, 2009; Shaw et al., 2006; Sowell et al., 2004; Yurgelun-Todd, 2007). This would, of course, need to be verified through other analytic techniques, such as structural and functional neuroimaging as well as electrophysiological measures such as electro-encephalography (EEG).

3.3. Case illustrations

So far, the results have demonstrated which sociodemographic variables influenced cognitive performance, which outcome measures warranted the use of local stratified norms, and under which conditions (i.e., for which outcome measures and for which sociodemographic groups) the use of non-local normative data was inadvisable. The purpose of the following case illustrations is to reinforce some of the principles and trends that have already been discussed in the preceding sections. The specific intention of the case illustrations is solely to provide clinicians with guidelines regarding test and norm selection, by referring to the cognitive test scores of two individuals with differing sociodemographic profiles.

I randomly selected one participant with advantaged quality of education, and another with disadvantaged quality of education for the case illustrations. I selected one measure to represent each cognitive domain, and converted all scores into *T*-scores, using two sets of norms: 1) non-local norms and 2) the demographically adjusted norms from this study (Appendix D). The two sets of *T*-scores for each participant are plotted in Figures 20 and 21 (having been converted so that for all measures, higher scores represent better performance). I used Mitrushina et al.'s (2005) suggested interpretive categories (see Table 96). The *T*-scores for each measure using both sets of norms, and the corresponding interpretive categories, are presented in Tables 97 and 98.

Table 96. *Interpretive Normative Categories Suggested by Mitrushina et al. (2005)*

Percentile	**T-score**	**Suggested Clinical Interpretation**
≥ 98	≥ 70	Very Superior
91 - 97	64 – 69	Superior
75 - 90	57 – 63	High Average
25 - 74	44 – 56	Average
9 - 24	37 – 43	Low Average
2 - 8	28 – 36	Borderline
< 2	≤ 27	Impaired

Case *A* (Figure 20 and Table 97) is a coloured, 12-year-old, English-speaking female who had completed 6 years of advantaged quality of education. Case *B* (Figure 21 and Table 98) is a coloured, 15-year-old, Afrikaans-speaking female with 10 years of disadvantaged quality of education. Both participants were right-handed.

3.3.1. Case illustration A

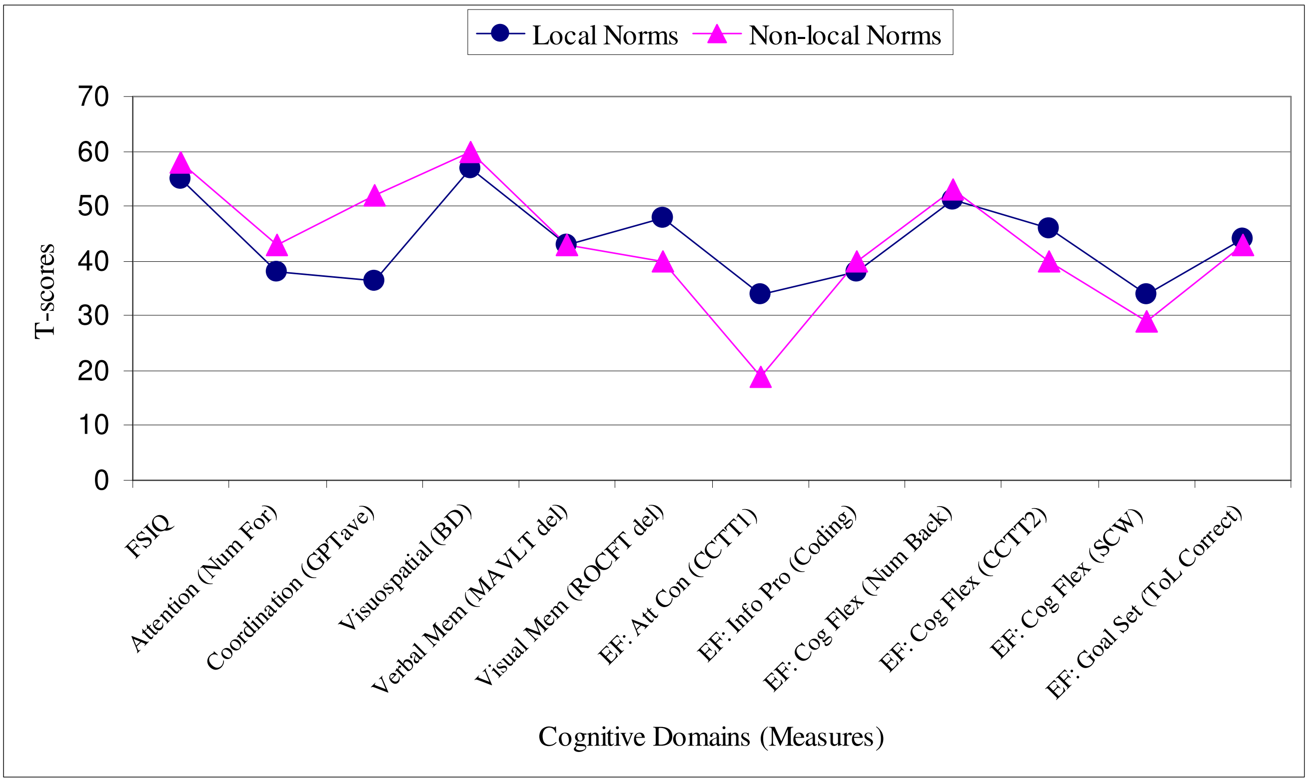

Figure 20. Case Study A: Profile of cognitive functioning using local and non-local norms for a right-handed, coloured, 12-year-old, English-speaking female, with 6 years of advantaged quality of education.

Figure 20 shows that there was considerable variability across domains with regard to the extent to which the local and non-local norms were compatible. For some measures, the converted *T*-scores using the two sets of norms were identical (MAVLT Delayed Recall, and ToL Total Correct) or near-identical in that they did not differ by more than 2 points (Block Design; Coding; and Numbers Backward). For other measures, differences between the scores derived from the different norms were subtle, in that they did not differ by more than one *T*-score SD (10) or by interpretive category (Numbers Forward; and SCWT Color-Word Page).

Although the WASI Short Form IQ scores differed by a category, there was only a 3-point different in *T*-scores. Although there is a categorical difference between high average and average, both scores remain within the broader “average” range. The implications of these findings are that either the non-local norms (specified in Table 97) or the local norms would be suitable to interpret the cognitive performance on these specific measures for participants matching the sociodemographic profile of individual *A*.

For the ROCFT Delayed Recall measure, the *T*-score differences did not exceed one SD, but resulted in a categorical shift downwards from average (using the local norms) to low average (using Meyers and Meyers’(1996) norms), indicating that the local norms are preferable for participants similar to individual *A*.

For CCTT Trial 2, although the *T*-score differences did not exceed one SD, the use of non-local norms resulted in a categorical downward shift from average to low average. For CCTT Trial 1, however, the dramatic downward shift (1.5 SDs) resulted in a categorical shift from borderline to impaired functioning. The use of Llorente et al.’s (2003) normative data is strongly contraindicated in order to prevent the false positive misdiagnoses of deficits in attentional control, as measured by the CCTT 2.

The cross-cultural comparison of the GPT norms demonstrated that the miscellaneous North American norms published in the Lafayette manual (2003) were too harsh for the study population. In the case illustrations, I used non-local data from another African country (Uganda). As Table 97 shows, the use of these other-African norms resulted in an upwards categorical shift from low average to average, and a difference in *T*-scores of 1.5 SDs, indicating that they are too lenient. The ramifications of these findings are that neither the American norms nor African non-local norms are suitable for interpreting performance on the

GPT for participants similar to individual *A*. Consequently, the use of the local norms derived from this study is strongly recommended in preference to the two cited alternatives.

Table 97. *Case Study A: Interpretive differences in cognitive performance using local and non-local norms*

Cognitive Domain	Cognitive Measure	Non-local Norms			Local Norms	
		Sample	**T-score**	**Interpretive Category**	**T-score**	**Interpretive Category**
Intelligence (*g*)	WASI Short Form IQ	12-15 years, USA (Psychological Corporation, 1999)	58 (IQ 112)	High Average	55 (IQ 107)	Average
Simple Attention	CMS Numbers Forward	12-15 years, USA (Cohen, 1997)	43	Low Average	38	Low Average
Fine Motor Coordination	GPT 1 Mean	18-36 years, Uganda (Robertson et al., 2007)	52	Average	37	Low Average
Visuospatial Ability	WASI Block Design	12-15 years, USA (Psychological Corporation, 1999)	60	High Average	57	High Average
Verbal Memory	MAVLT Delayed Recall	16-29 years, Hispanic USA (Pontón et al., 1996)	43	Low Average	43	Low Average
Visual Memory	ROCFT Delayed Recall	12-15 years, USA (Meyers & Meyers, 1996)	40	Low Average	48	Average
EF: Attentional Control	CCTT Trial 1	12-15 years, USA (Llorente et al., 2003)	19	Impaired	34	Borderline
EF: Information Processing	WISC-IV Coding	12-15 years, UK (Wechsler, 2004)	40	Low Average	38	Low Average
EF: Cognitive Flexibility	CMS Numbers Backward	12-15 years, USA (Cohen, 1997)	53	Average	51	Average
	CCTT Trial 2	12-15 years, USA (Llorente et al., 2003)	40	Low Average	46	Average
	SCWT Color-Word Page	12-14 years, USA (Golden et al., 2003)	29	Borderline	34	Borderline
EF: Goal Setting	ToL Total Correct	12-15 years, USA (Culbertson & Zillmer, 2001)	44	Average	44	Average

Note. WASI = Wechsler Abbreviated Scale of Intelligence; CMS = Children's Memory Scales; GPT = Grooved Pegboard Test; MAVLT = Maj's Auditory Verbal Learning Test (WHO/UCLA Versions); ROCFT = Rey-Osterrieth Complex Figure Test; CCTT = Children's Color Trails Test: WISC-IV = Wechsler Intelligence Scale for Children (4th UK Edition); SCWT = Stroop Color-Word Test; ToL = Tower of London; EF = Executive Functioning.

Figure 20 and Table 97 show that the three measures of Cognitive Flexibility are discrepant, regardless of which norms are used to interpret them. If the local norms are used, the T-scores for these measures differ widely (34 to 51) and represent interpretive ranges from borderline to average. The SCWT Color-Word Page provides the lowest estimate of Cognitive Flexibility, using either the local norms or Golden et al.'s (Golden et al., 2003) norms. Further analyses of the intercorrelations between these measures, and analyses derived from clinically impaired samples would help to clarify which test/s measure Cognitive Flexibility most reliably.

Participant *A* achieved lower T-scores for CMS Numbers Forward than for Numbers Backward (e.g., 38 and 38, using local norms), which is unusual, given that the former task is more difficult than the latter (Lezak et al., 2004). It is highly unlikely that this finding indicates superiority in the one domain over the other. It is more likely that the participant exerted a more concerted effort during the more challenging task. This finding is consistent with observations that simple tasks like rote-learning and rote-copying may yield little challenge or entertainment value for adolescents, and thus not evoke optimal effort (Cocodia et al., 2003; Van der Merwe, 2008; Van Tonder, 2007). In Case *A*, it would be useful to verify whether the relatively poorer performance on the easier subtest was attributable to inattention or to insufficient effort by referring to another outcome measure of Simple Attention (e.g., MAVLT Trial 1) as a source of confirmatory or contradictory collateral information.

3.3.2 Case illustration B

Figure 21 and Table 98 show that for Case *B*, except for the GPT, all *T*-scores derived from non-local norms were lower than those derived from the stratified local study norms. Unlike Case *A*, who had received advantaged quality of education, there were no identical *T*-scores for Case *B*, who had received disadvantaged quality of education. Consistent with the findings discussed in Section 3.1, four of the measures (MAVLT Delayed Recall, Numbers Backward, SCWT, and ToL Total Correct) appeared to demonstrate less bias than the other measures, in that the mean differences between T-scores were small (> 1 SD) and did not result in category shifts outside of the overall average range.

Similar to the findings for Case *A*, the GPT T-scores for Case *B*, using Robertson et al.'s (2007) Ugandan normative data (which were derived from an older sample than the study sample), appeared to over-estimate Fine Motor Coordination. Out of interest (not shown in the corresponding figure or table), using the miscellaneous North American norms published in the Lafayette manuals (2003), Case *B*'s T-score was 25, which probably under-estimates the participant's real ability. Given the three different T-scores, the interpretive categories for Fine Motor Coordination, as measured by the GPT ranged from impaired to high average, leaving practitioners unsure of which score to trust. In this situation, I would argue that out of the three sets of norms, the stratified study norms, derived from a sample that closely resembles the participant's sociodemographic profile, are most likely to provide the best estimation of the participant's real abilities.

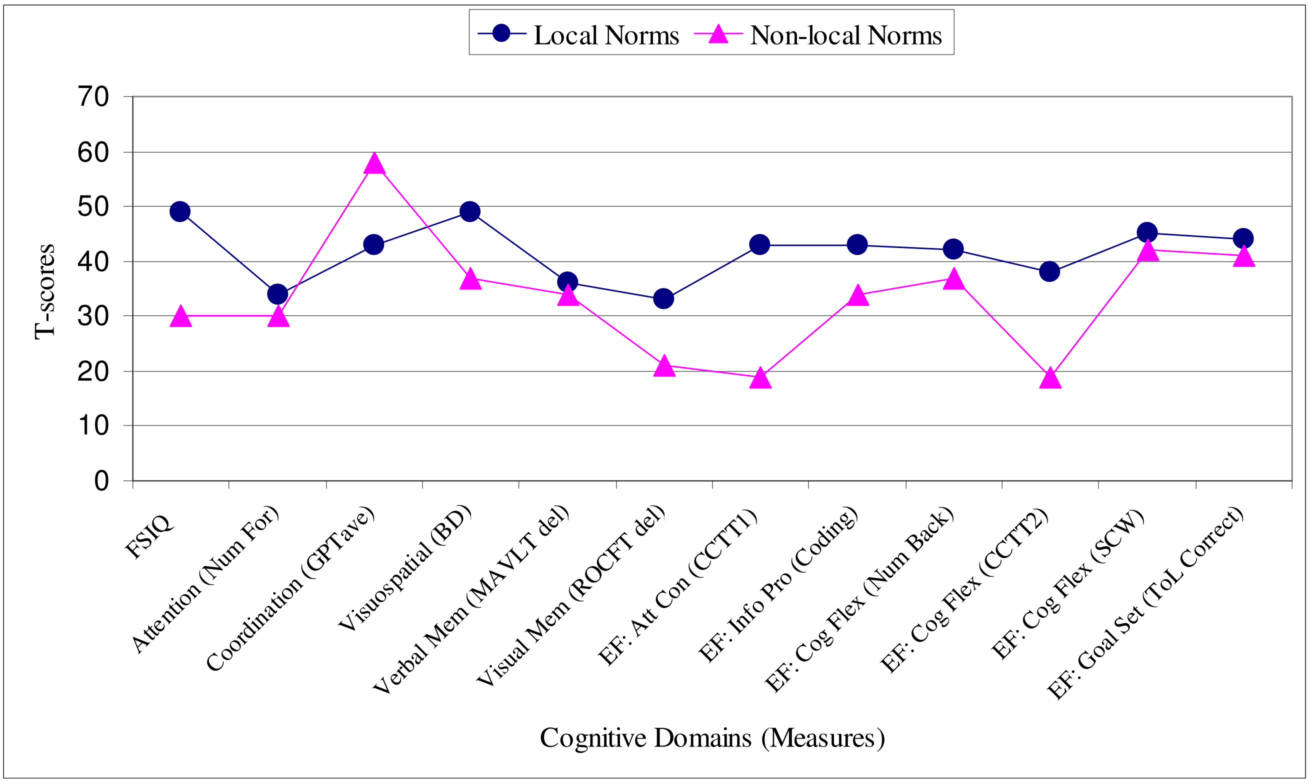

Figure 21. Case study B: Profile of cognitive functioning using local and non-local norms for a right-handed, coloured, 15-year-old, Afrikaans-speaking female, with 10 years of disadvantaged quality of education.

The two Block Design T-scores for Case *B* are discrepant beyond one SD, and result in an interpretive category shift. However, as this shift from low average to average is still located in the broad average range, is not likely to have serious interpretive ramifications. The *T*-score difference for Coding does not exceed one SD, but does elevate the participant's interpretive category from borderline (using Wechsler's (2004) UK standardization norms for the WISC-IV) to low average (using the stratified local study data).

Table 98. *Case Study B: Interpretive differences in cognitive performance using local and non-local norms*

Cognitive Domain	Cognitive Measure	Non-local Norms			Local Norms	
		Sample	**T-score**	**Interpretive Category**	**T-score**	**Interpretive Category**
Intelligence (*g*)	WASI Short Form IQ	12-15 years, USA (Psychological Corporation, 1999)	30 (IQ 70)	Borderline	49 (IQ 99)	Average
Simple Attention	CMS Numbers Forward	12-15 years, USA (Cohen, 1997)	26	Impaired	34	Borderline
Fine Motor Coordination	GPT 1 Mean	18-36 years, Uganda (Robertson et al., 2007)	58	High Average	43	Low Average
Visuospatial Ability	WASI Block Design	12-15 years, USA (Psychological Corporation, 1999)	37	Low Average	49	Average
Verbal Memory	MAVLT Delayed Recall	16-29 years, Hispanic USA (Pontón et al., 1996)	34	Borderline	36	Borderline
Visual Memory	ROCFT Delayed Recall	12-15 years, USA (Meyers & Meyers, 1996)	21	Impaired	33	Borderline
EF: Attentional Control	CCTT Trial 1	12-15 years, USA (Llorente et al., 2003)	19	Impaired	43	Low Average
EF: Information Processing	WISC-IV Coding	12-15 years, UK (Wechsler, 2004)	34	Borderline	43	Low Average
EF: Cognitive Flexibility	CMS Numbers Backward	12-15 years, USA (Cohen, 1997)	37	Low Average	42	Low Average
	CCTT Trial 2	12-15 years, USA (Llorente et al., 2003)	19	Impaired	38	Low Average
	SCWT Color-Word Page	12-14 years, USA (Golden et al., 2003)	42	Low Average	45	Average
EF: Goal Setting	ToL Total Correct	12-15 years, USA (Culbertson & Zillmer, 2001)	41	Low Average	44	Average

Note. WASI = Wechsler Abbreviated Scale of Intelligence; CMS = Children's Memory Scales; GPT = Grooved Pegboard Test; MAVLT = Maj's Auditory Verbal Learning Test (WHO/UCLA Versions); ROCFT = Rey-Osterrieth Complex Figure Test; CCTT = Children's Color Trails Test: WISC-IV = Wechsler Intelligence Scale for Children (4th UK Edition); SCWT = Stroop Color-Word Test; ToL = Tower of London; EF = Executive Functioning.

However, the differences in T-scores between other measures are not only numerically divergent, but result in interpretive categorical differences that, if the non-local norms are used, define participant *B*'s functioning as impaired across four domains. *T*-scores for the Numbers Forward measure, using Cohen's (1997) USA standardization normative data published in the CMS manual, do not deviate by more than one SD, but do result in an interpretive shift from borderline (using the study norms) to impaired functioning. Case *B*'s ROCFT Delayed Recall T-scores differ by more than one SD and shift the interpretation from borderline to impaired functioning (using Meyers and Meyers (1996) USA standardization norms published in the manual in comparison to the study norms).

As in Case *A*, the CCTT appears to demonstrate the highest degree of cultural bias, if Llorente et al.'s (2003) USA normative data, published in the test manual, are used to interpret scores representing the domains of Attentional Control and Cognitive Flexibility. For both CCTT measures, *T*-score differences between the non-local and local norms were in the region of 2 SDs (24 for Trial 1 and 19 for Trial 2) and resulted in two downward categorical shifts from low average to impaired functioning. Both case illustrations and the analyses in section 2.1 demonstrate that although the CCTT itself is not culturally biased, the use of the published normative data for participants with the sociodemographic profile of the study population is likely to result in faulty inferences, elevating the potential for false positive misdiagnoses of executive dysfunction.

The *T*-scores derived from non-local norms for Case *B* illustrate that some nonverbal measures (e.g., SCWT and ToL) appear to be culture-fair, but others (specifically Block Design, ROCFT, Coding, and CCTT) demonstrate considerable cultural bias against Afrikaans-speaking, coloured participants with disadvantaged quality of education. Case *B* corroborates the evidence provided in other sections of this study, and demonstrated in other South African research, that nonverbal cognitive tests are not necessarily devoid of cultural bias (C.D. Foxcroft, Paterson, Le Roux, & Herbst, 2004; Kanjee, 2005; Nell, 2000; Shuttleworth-Edwards et al., in press).

The discrepancies between the IQ measures presented in Table 98 are also noteworthy. The use of the Psychological Corporation's (1999) USA standardization data published in the test manual, in comparison with the local norms, results in the lower scores by 19 *T*-score units, and by 29 IQ-score units. The possible classification of Case *B*'s general intellectual functioning as either borderline (according to the non-local norms) or average (according to the local norms), in the context of four other domains (Simple Attention, Visual Memory, Attentional Control, and Cognitive Flexibility) that could be classified as impaired (according to the local norms) or borderline to average (according to the local norms) poses interpretive dilemmas for practitioners.

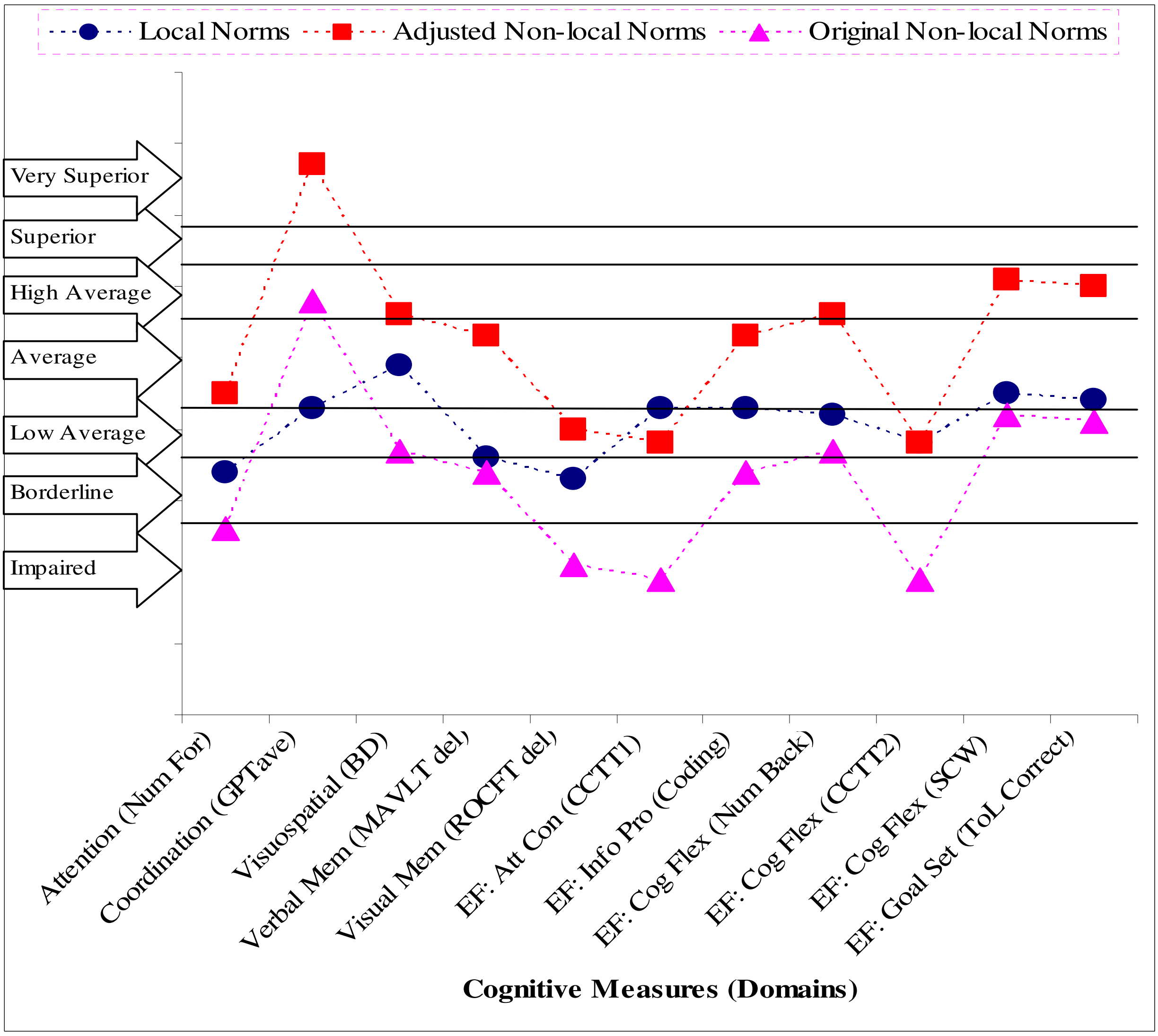

Figure 22. Case Study *B*: Profile of cognitive functioning using local norms, non-local norms, and adjusted non-local norms for a right-handed, coloured, 15-year-old, Afrikaans-speaking female, with 10 years of disadvantaged quality of education.

Three possible strategies (previously discussed) used to deal with these interpretive dilemmas typically include: 1) interpreting the cognitive performance at face value, using the non-local data; 2) adjusting the scores (derived from the non-local norms) uniformly by a set amount (e.g., relative to the IQ score, which in this case, meant adding 19 *T*-score units to the original *T*-scores because of the difference between scores shown in Table 98); or 3) using appropriately stratified normative data derived from a sample that closely matches the sociodemographic profile of the test participant. Figure 22 provides a graphic illustration of the interpretive complexities associated with each of the three abovementioned strategies.

The first strategy, that is, interpreting Case *B*'s cognitive scores at face value, using non-local norms is problematic for some of the measures, as it elevates the potential for false-positive misdiagnoses of subnormal functioning in the domains of Visual Memory, Attention, Attentional Control, and Cognitive Flexibility. The practical ramifications of such misdiagnoses differ according to the purpose of the cognitive assessment. If, for example, Case *B* was a soccer player, and had undergone cognitive testing to determine whether heading the ball, as a potential source of repetitive concussive injury, was associated with cognitive functioning, interpretation of the unadjusted scores may have resulted in unnecessarily disallowing her sporting activities.

If, however, Case *B* had actually sustained mild head injury as a result of repeatedly heading the soccer ball, the second strategy (i.e., that of uniformly adjusting the scores upward by a fixed amount) would have incurred false negative misdiagnoses (as all the adjusted *T*-scores shown in Figure 22 were located outside of the impaired or borderline interpretive ranges). The consequences of such misdiagnoses may have allowed Case *B* to continue heading the soccer ball, thereby exposing her to the possibility of repetitive concussive brain insult, and its negative sequelae, e.g., suboptimal academic performance (Shuttleworth-Edwards et al., 2008; Shuttleworth-Edwards & Whitefield, 2007).

Because of the strong evidence (in this study and other previously cited studies) that the profile of disadvantaged quality of education, Afrikaans language, and coloured race is associated with lowered performance in many cognitive tests, it may be clinically useful to adjust scores to ameliorate the effects of cross-cultural bias. However, Section 2.1, and both Case Studies *A* and *B* have shown that the extent and severity of cultural bias varies considerably across the cognitive measures. Although the principle of upward adjustment may be sound in certain contexts, uncertainty regarding which scores to adjust, and by how much, hamper the implementation of a potentially useful principle.

Adjusting scores in relation to the specific IQ score used in the case illustrations is problematic for numerous reasons. Firstly, the WASI version used in this study is experimental and in need of further refinement (as described in detail in Section 3.1.11). Future studies would be necessary to ascertain whether and how well the short form FSIQ (which only includes Block

Design and Vocabulary) correlates with the four-test FSIQ. Future studies would also need to investigate how well the WASI correlates with more comprehensive Wechsler scales (e.g., the WISC-IV) as a valid and reliable measure of general intellectual ability in the study population. Secondly, the PCA analyses demonstrated that the WASI FSIQ was not uniformly associated with the other cognitive measures. More detailed analytic techniques would be necessary to specify which measures are and are not associated with the WASI outcome measures. Thirdly, giving precedence to one cognitive measure above others, and over collateral sources of information, may obscure important information regarding the cognitive functioning of the individual.

The preceding discussion has demonstrated that the first and second strategies for resolving interpretive dilemmas (i.e., using non-local norms; or using uniformly IQ-adjusted non-local norms) both demonstrated the potential for faulty inferences to be made about the cognitive functioning of Case *B*.

Figure 22 shows that the third strategy (i.e., using appropriately stratified local norms) would have resulted in a distribution of scores all within the ranges of high-borderline to average functioning. In the hypothetical scenario regarding the return-to-play decision for Case *B*, the chances of making diagnostic errors were reduced by the use of well-matched norms.

However, although the purpose of the case illustrations was to reinforce some theoretical principles and to provide guidelines relating to norm selection, I emphasize that, regardless of which normative data are used, psychometric scores alone do not provide sufficient information to make clinical judgments such as whether Case *B* should have continued playing soccer. The psychometric data would need to be supplemented with other quantitative and qualitative sources of information (e.g., detailed clinical history-taking and collateral information regarding scholastic functioning).

With regard to Case *B*, the psychiatric and history-taking interviews, MRI, and EEG data recordings revealed no abnormalities. The data derived from the local norms (see Figure 22) are thus likely to provide a more meaningful characterization of participant *B*'s cognitive functioning than the data derived from non-local (unadjusted or adjusted) norms. Furthermore, the participant's school report indicated a low school absenteeism rate (4 days absent in one school year), no grade repeats or failures, and low-to-average academic achievement in the preceding school year (lowest achievement: physical sciences = 42%; highest achievement: life orientation = 59%; first language Afrikaans = 50%; second language English = 44%; mathematics = 48%; aggregate performance = 50%). The school achievement record is consistent with the profile of cognitive functioning, which ranged from high-borderline to average cognitive abilities. Taking all of this information into account, it is clear that the use of the local normative data is more appropriate than the use of non-local data for this individual.

4. Evaluation and Recommendations

It is challenging to evaluate cognitive performance in multicultural, multilingual communities that are characterized by socioeconomic and educational disparities. This doctoral study provides one possible methodological model to address the abovementioned challenge within a systematic empirical framework. The study makes a contribution to the field of psychometric assessment in culturally and linguistically complex societies by demonstrating ways in which tests can be adapted, administered, and evaluated for sociodemographic confounds and cultural bias.

The output yielded by the study consists of test material that has been translated and adapted, as well as appropriately stratified normative data, gathered from participants who were tested in their first language for a compendium of cognitive tests. These adapted tests and preliminary normative data are thus able to be used in clinical practice and research settings catering for the population of 12- to 15-year-old, coloured and white, Afrikaans- and English-speaking urbanized adolescents resident in the Cape Town metropole.

This study met all of the eligibility criteria for inclusion into Mitrushina et al.'s (2005) international meta-analytic studies. These criteria include: 1) descriptions of medical and psychiatric exclusion criteria; 2) detailed descriptions of administrative procedures; 3) minimum sample size of 50; 4) descriptions of sample composition (e.g., geographic recruitment region, handedness, and race); 5) reporting of gender composition and educational level; 6) grouping of data into limited age intervals (i.e., not exceeding 10 years in one group); and 7) reporting sufficient data, including sample sizes, means, standard deviations, and score ranges. As such, the normative data derived from this study are suited to cross-cultural comparisons. Furthermore, the cross-cultural comparisons between study data and data derived from other geographical locations and cultural contexts, for each cognitive test, provide practitioners with specific guidance regarding the relative suitability and clinical utility of the norms for specific sociodemographic subgroups.

4.1. Study strengths, limitations and future directions

4.1.1. Study design and sampling

Strengths: For this cross-sectional normative study, thorough screening procedures were used and stringent exclusionary criteria were applied so as to ensure that the data adequately characterized typical cognitive functioning in the prescribed age-range. Group sizes were balanced for the categorical variables of sex, language, and SES. The racial groups were imbalanced (approximately two-thirds of the participants were coloured and one-third white), but the racial distribution of the sample was reasonably representative of the racial distribution of these two groups in the Western Cape (i.e., 50% coloured, 20% white; Statistics South Africa, 2007). Because the sample of participants with disadvantaged quality of education consisted only of coloured individuals, between-race comparisons were only made within the group with advantaged quality of education.

Opinions vary about acceptable sample sizes for normative studies. By the standards of statistical purists, sample sizes for this study (ranging from $N = 194$ to $N = 286$ for the three test groups) were inadequate in comparison with large standardization studies with sample sizes in the thousands. If adapted tests are considered to be *new* instruments, the sample size for the WASI and Phonemic Fluency tests ($N = 286$) is also inadequate, according to Foxcroft and Roodt's (2005) recommended minimum of 400 for new tests. From this perspective, it could be argued that the *norms* from this study should be qualified as *exploratory*, *preliminary* or normative *indicators*, and the research defined as an *experimental* or *pilot* study.

On the other hand, the minimum sample size ($N = 50$) for inclusion into Mitrushina et al.'s (2005) meta-analytic studies is considerably more lenient. According to this international standard, the sample sizes for this study are more than three times greater than the recommended sample size. For the SCWT, the study sample size was greater than that of the standardization sample (Golden et al., 2003). For some tests, the study sample size exceeded the sample sizes used to derive normative data, as presented in international peer-reviewed journals, for example, CLOX (Royall et al., 1998); GPT peg removal (Bryden & Roy, 2005); MAVLT (Pontón et al., 1996); and Semantic Fluency (Kavé et al., 2009; Ruffieux et al., 2010). In comparison to the South African normative studies cited in Table 1, the sample size for this study is smaller than three of the studies, but is considerably larger (i.e., double or triple the size) than six of the cited studies conducted in the last decade.

Limitations: The convenience sampling procedure in this study was less rigorous than the randomized sampling procedures used in some standardization studies (e.g., for the WASI (Psychological Corporation, 1999); or some South African normative studies, for example, for the WAIS-III (Claassen et al., 2001), or the WISC-IV (Shuttleworth-Edwards et al., in press). Consequently, the sizes of certain subgroups were not balanced (e.g., within the 12-year-old age-group with advantaged quality of education, there were fewer Afrikaans-speakers than English-speakers).

Regardless of one's perspective on sample size adequacy, in tests for which norms were stratified by three or more independent variables, certain cell sizes were small. In particular, data for 12-year-old Afrikaans-speakers with advantaged quality of education has limited generalizability due to small cell sizes, and should be interpreted with caution. Similarly, data for particular measures that had small cell sizes in some of the subgroups (see details in Section 3.1.) should also be used with caution, and supplemented with other information. For example, for Phonemic Fluency, three WASI subtests (Block Design, Matrix Reasoning, and Similarities), and WISC-IV Coding, cell sizes were small ($n < 20$) for some of the subgroups; and for CMS Numbers and the WASI Vocabulary subtest, cell sizes were very small ($n < 10$) for certain subgroups.

Due to pragmatic reasons, different testers were used at schools with differing profiles in terms of language and quality of education. The possibility of inter-site differences in performance cannot be ruled out. I did not analyse inter-site reliability because of the strong possibility of confounded results.

Future Directions: The carefully stratified normative data derived from this study are generalizable to participants meeting the specific sociodemographic profile of this study. However, it cannot be assumed that they are generalizable to other groups in the Western Cape (e.g., Xhosa-speaking individuals, or black adolescents in general). The data are also region-specific and may not be appropriate for 12- to 15-year-old, coloured and white, Afrikaans- and English-speaking participants resident in the other provinces of South Africa. However, the similarity of the findings of this study to data for 12- to 13-year-old, coloured and white, Afrikaans- and English-speakers in the Eastern Cape from data collected by Shuttleworth-Edwards et al. (in press) provides tentative evidence that norms may be inter-regionally comparable.

Because of the shortage of norms in South Africa, it would be useful to build on the existing resources by conducting studies using the same test battery on other samples. The first priority would be to replicate this study in an age-matched sample of urbanized, black, Xhosa-speaking and English-speaking participants. It would also be useful to extend the database in other ways, for example: 1) in samples younger than 12 and older than 15 years; 2) in the other South

African provinces; 3) in the nine official South African languages other than Afrikaans and English.

Supplementary data for the dissertation study would be useful for subgroups where cell sizes were small (e.g., 12-year-old, Afrikaans-speakers with advantaged quality of education) and for cognitive tests where cell sizes were small in some of the stratified subgroups. Furthermore, it would be useful to replicate this study in populations with clinical conditions, in order to ascertain which cognitive measures discriminate between typical and atypical functioning. Longitudinal follow-up studies of the current study sample would be useful for numerous reasons: 1) to establish the trajectory of cognitive performance over time; 2) to clarify which developmental lags (currently associated with poor quality of education or younger age) may improve or persist with advancing age and education; and 3) to ascertain the psychometric properties of the instruments (e.g., test-retest reliability and ecological validity).

All the participants tested in this study were enrolled at school when they were tested. However, not all adolescents in the Western Cape are attending school. Of the 1 318 932 learners who started school in 1999, only 643 546 wrote the matriculation exams in 2010, indicating a very high school-dropout rate in that less than half of the cohort did not complete their schooling (Kemp, 2011). Future studies would be necessary to determine whether the study norms are appropriate for adolescents in the Western Cape who have terminated school early, thus having been denied the benefits of the full 12 years of formal schooling.

Because I used supplementary data from a parallel study initiated after the primary study for the WASI and Verbal Fluency tests, the possibility of potential inter-study confounds in scores for these measures cannot be ruled out. For the parallel study, although exclusionary criteria did not differ from the primary study, some aspects of the screening procedure were different. Specifically, (a) different DSM-IV-based clinician-assisted screening instruments were used, and (b) the screening interviews for participants in the primary study were conducted by a psychiatrist, whereas those for participants in the supplementary study were conducted by a clinical psychologist. Additionally, the two studies were conducted at different sites in the Cape Town region, and there were fewer tests in the compendium for the supplementary study.

4.1.2. Test selection

Strengths: This study presents normative data for a compendium of tests that represent cognitive functioning across a range of functional domains that are typically evaluated during psychometric assessments. The tests were carefully selected according to criteria that included psychometric credibility; age-appropriateness; culturo-linguistic appropriateness; cross-cultural utility; and idiosyncratic reasons that are explicated for each test in Section 3.1. The selected tests (except the CMS Stories subtest) were generally found to be appropriate for the test population.

Limitations: The CMS Stories subtest was not well tolerated by the participants, produced results that were difficult to interpret, and was loaded with culturally-unfamiliar content. The decision to retain the original story content to test memory under overload conditions was, in retrospect, problematic. I suspect that the unfamiliar terms and the complexity of the stories may have interfered with the measure's ability to reflect memory performance and capacity accurately.

Future Directions: The utility of other stories would need to be investigated in order to assess verbal memory embedded in a semantic context. It would be necessary to establish whether the story designed and used in clinical practice by Hemp (2010), for example, may be more suitable for the local population.

Grieve and Viljoen (2000) has highlighted the potential value of using computerized test batteries. In their study, computerized versions of the Austin maze, the Halstead-Reitan Category Test, and the RSPM were used. These tests, which utilized the arrow buttons on the keyboard (and which thus did not require specialized computing skills) were well tolerated by a sample of black Venda-speaking students with disadvantaged quality of education from the North West Province. Given the prohibitive costs of some "paper-and-pencil" psychometric instruments (e.g., WISC-IV), it may, in certain conditions, be more cost-effective to use test material that is downloadable to laptop computer. Computerized tests may be particularly age-appropriate for urbanized adolescents who are familiar with gaming technology and use computers at school. These tasks may be more engaging and elicit better performances than some of the more traditional measures, e.g., CMS Numbers (Cocodia et al., 2003).

Other South African studies have highlighted the pragmatic utility of testing large numbers of participants over a short span of time by using group-administered tests (Boon & Steel, 2005; Jinabhai et al., 2004; Knoetze et al., 2005) . Future studies using group-administered tests could help to expand the collection of normative data in South Africa.

4.1.3. Test adaptation

Strengths: This study differs from most other South African normative studies in that the test material was formally evaluated and adapted (where necessary) to suit the cultural and linguistic profile of the test population. I adopted a principled, empirical approach to evaluate whether test material was culturally biased. This approach was in accordance with international precedents (e.g., Ardila, 1998; Brickman, Cabo, & Manly, 2006; Carter et al., 2005; Ostrosky-Solis, Ardila, & Rosselli, 1999; Pontón & Leon-Carrion, 2001; Wong, 2006) and the guidelines recommended by the International Test Commission (Kanjee, 2005). These guidelines include consulting with cultural experts and well-qualified translators, describing methodology conducting pilot studies, and reporting norms.

The consultants included clinical and educational psychologists, professional linguists and translators, and local representatives of the community who were familiar with language and cultural practices within the specified sample. The first stage of the consultation process was to evaluate which tests or items needed to be modified, removed, or replaced. The purpose of the evaluations was to reduce inter-lingual differences in difficulty, while retaining inter-item difficulty levels. For example, the WASI Vocabulary items needed to increase in level of abstraction in ascending order, but each item was intended to be equally difficult for English- and Afrikaans-speakers.

Tests that were rated as culture-fair were translated according to Brislin's (1983) recommendations, which include translation, independent back-translation, and the resolution of differences between the original and translated versions (Mitrushina et al., 2005). This formal translation process was employed to reduce the potential for distortions of meaning resulting from inexact translations and idiosyncratic linguistic variations.

Tests that were evaluated as unbiased (in terms of test material) were not modified; these tests were the CCTT; CLOX; ROCFT; SCWT; ToL; Semantic Fluency; Coding; and the WASI Performance subtests (Block Design and Matrix Reasoning). The GPT required one minor modification to the test instructions. It is unlikely that this modification (i.e., an explanation of the shape of the pegs) would have negatively affected performance on the test. The distractor list and recognition subtest in the MAVLT required three word replacements, but List A was judged to be suitable for use in the local population in its original format. The WASI Similarities subtest warranted only one slight modification in the form of swapping the presentation order for one pair of words. The WASI Vocabulary subtest needed numerous item substitutions, however (see details in Section2.5.2.6).

The history of phonemic fluency testing has exhibited considerable variation in the extent to which researchers have contemplated which letters to use for non-English speakers. In the more casual approaches, English letters have merely been substituted with a phonetically similar letter from another language (e.g., the English *F* in English has been replaced by the Afrikaans *V*). More rigorous approaches have been adopted by others (e.g., Borkowski et al., 1967; Gollan et al., 2002; Senhorini et al., 2006). In line with the spirit of scientific enquiry exhibited in the latter approach, I conducted a separate sub-study to establish the most compatible letter set for English- and Afrikaans-speakers (see details in Section 2.5.2.4).

Limitations: The results demonstrated that the modifications were adequate for most measures. However, despite our efforts to adapt measures in the attempt to ensure linguistic equivalence, the possibility of language bias towards Afrikaans-speakers in the WASI Verbal subtests cannot be ruled out, and may need further refinement. The CMS Stories subtest was unsuitable for the test population (as explained in Section 4.1.3.).

Future Directions: The WASI Verbal subtests demonstrated complex intra-cultural differences. It would be useful to assess the items for potential bias, and investigate other contributory factors that may explain the differences in performance between the sample subgroups. It is unknown whether the relatively poorer performance on these measures by the Afrikaans-coloured-disadvantaged group, in particular, and Afrikaans-speaking, coloured and white groups in general, indicates that these subgroups exhibit differing capacities for abstraction, or whether particular test items are linguistically and culturally biased. Other factors worthy of further investigation include the impact of bi- and multi-lingualism; language mixing; reading and comprehension skills; and degree of exposure to same-language media and learning materials. Furthermore, it would be useful to find an alternative, culturally-appropriate measure of story memory as a replacement for the CMS Stories subtest.

4.1.4. Statistical analyses

Strengths: The analytic techniques (ANCOVAs, ANOVAs, LSD tests, and PCAs) provided a systematic and principled means of evaluating the impact of sociodemographic factors on participants' cognitive performance on the individual tests and on composite functional domains. It was possible to conduct detailed analyses of the relative impact of the sociodemographic variables on parametric data.

Limitations: The non-normally distributed data for the error scores in this study were not unusual or unexpected, and have been documented in other normative studies, for example: GPT Drops (Bryden & Roy, 2005; Bryden, Roy, Rohr, & Egilo, 2007; Mitrushina et al., 2005; Strauss et al., 2006); AVLT Repetitions and Insertions (Pontón, Gonzalez, Hernandez, Herrera, & Higareda, 2000; van den Burg & Kingma, 1999); SCWT Errors and Interference scores (Golden, 1975, 1978; Golden & Freshwater, 2002; Golden et al., 2003); and ToL Time and Rule Violations (P. Anderson et al., 1996; Culbertson & Zillmer, 2001). Because of the statistical properties of the data, it was not possible to quantify the relative influence of the independent variables on the aforementioned measures. Consequently, for all error scores in the test compendium, I presented descriptive normative data for the whole sample, and did not create normative conversion tables.

For reasons explained in Section 2.6.2.5., statistical significance levels were not Bonferroni-adjusted to compensate for possible Type I error. Consequently, there is a risk that some of the differences in performance between the subgroups may have been due to chance. However, for each cognitive measure, I evaluated the extent to which the statistically significant differences were clinically meaningful.

Future Directions: It is possible that error-score data may be normally distributed in clinical samples (e.g., adolescents with impulse control disorders, externalizing disorders, or executive dysfunction resulting from a variety of conditions). Error scores have been found to be useful in detecting subtle cognitive slippage, which has shown to be clinically useful in milder neuropathological conditions where overt cognitive impairment is difficult to detect (e.g., Llorente et al., 2004; Llorente et al., 2002). Consequently, future studies evaluating the relative impact of the sociodemographic variables on error scores (e.g., for the CCTT, MAVLT, Verbal Fluency, and ToL) may be clinically informative.

In journal publications, it is unusual to present normative data for a large number of outcome measures as presented in this study. Consequently, in attempting to publish the results of this study, I will focus on one, or a few tests in one article. For such analyses, Bonferroni adjustments would be applied to reduce the risk of Type I error.

4.1.5. Operizationalization of quality of education

Strengths: This study, and other recent South African normative studies, have highlighted the importance of evaluating the effects of quality of education on cognitive test performance, relative to other sociodemographic variables, particularly language and race (Cavé & Grieve, 2009; Grieve & van Eeden, 2010; Shuttleworth-Edwards, Donnelly et al., 2004; Shuttleworth-Edwards, Kemp et al., 2004; Shuttleworth-Edwards et al., in press; Shuttleworth-Jordan, 1996). In all of these studies, quality of education has been operationalized as a dichotomous categorical variable, differentiating between groups with exposure to better quality (advantaged) or poorer quality (disadvantaged) education (defined in relation to aspects such as material and instrumental resources, facilities, infrastructure, quality of tuition, and teacher-learner ratio). Although the two categories have been useful in demonstrating profound differences in cognitive test performance between such groups, few studies (including mine) have evaluated the extent of heterogeneity within the two categories of quality of education.

Limitations: Because the study sample was drawn from many different schools in the Cape Town region, it is possible that there was a range of cognitive performance within the crude but pragmatically useful bands of advantaged and disadvantaged quality of education. The purpose of the study was not to measure quality of education. However, the potent effect of quality of education on cognitive functioning, relative to the other sociodemographic variables, indicates that South African normative research may benefit from further enquiry into the factors that contribute toward relatively advantaged/disadvantaged quality of education.

Future directions: In future studies, it may be interesting to operationally define quality of education as a continuous variable, or as a categorical variable with more than two subgroups. It would also be beneficial to investigate research questions relating to the dynamic process of education, to clarify certain questions, for example: 1) how have the post-apartheid changes to the South African educational system (particularly outcomes-based education) affected the way in which children are taught to think and process information? 2) What are the effects of moving from disadvantaged to advantaged education systems, and how long does it take to attenuate the effects of previous poor education? 3) Which factors related to quality of education exert the strongest influence on cognitive functioning? 4) Does improved quality of education affect overall cognitive functioning, or is it restricted to discrete functional domains?

One of the factors surmised to be related to poor quality of education is the quality of language used by teachers (Kemp, 2011). This topic may be useful in explicating the differences in performance between English- and Afrikaans- speakers in our study. The complex interactions between factors related to language and the effects on cognitive functioning warrant much more detailed investigation than was provided in the current study, for example: 1) the impact of differing languages at home and at school; 2) the availability of reading and educational materials in languages other than English; 3) level of language proficiency and mastery in bilingual and multilingual individuals; 4) emerging hybrid language systems; and 5) familial attitudes to language proficiency. The impact of quality of language (as an independent sociodemographic variable) on cognitive test performance may prove to be informative in the future research.

4.1.6. Normative data

Strengths: One of the relative strengths of this study is the creation of carefully stratified descriptive normative data for Afrikaans-speakers. Such data were not readily available for that population, or more generally, for coloured individuals as a whole. For each cognitive outcome measure, the norms are very specifically stratified according to the relative contributions of age, sex, language, quality of education, and race (within advantaged quality of education). These empirically stratified normative data thus provide a reliable source of reference for practitioners to ascertain to what extent the performance of patients or research participants deviates from the profile of this relatively large group of typically developing adolescents. Because the norms have been carefully stratified, if the normative data are used for individuals that match the sociodemographic profile of the relevant stratified subgroup, the likelihood of practitioners making false positive and false negative misdiagnoses (as a result of inappropriate normative reference material) is minimized.

Furthermore, for each parametric cognitive outcome measure, I created a set of corresponding normative conversion tables, appropriately stratified by the empirically-established influential sociodemographic factors of race, age, sex, language, and quality of education. The norm conversion tables enable practitioners to transform raw scores into the standardized score of their preference. They also facilitate the cross-cultural comparisons of data that are reported in different units of measurements. According to the characteristics of the standard normal distribution, raw scores can be converted to *z*-scores, standard scores, *T*-scores, percentiles, or standardized (or “IQ”) scores, using the conversion tables located in Appendix D. Once raw scores have been transformed using the conversion tables, cognitive performance on particular measures can be classified into clinical interpretive categories. The specific ranges of standardized scores allocated to different interpretive categories differ according to context and author (e.g., Mitrushina et al.'s (2005) interpretive categories, which are reported in Table 96).

Limitations: The interpretive system by Mitrushina et al. (2005) defines *impairment* in one interpretive category (< 2^{nd} percentile). I used this system because the focus of this study is on the range of *normal* functioning. The interpretive cutoff point for impairment used in this study would, however, be insensitive to differentiating between levels of severity of cognitive impairment in participants with neurological dysfunction.

Future directions: For the purposes of differentiating between levels of severity of abnormal cognitive functioning, the interpretive system devised by Heaton et al. (1992; 2004), for example, would be preferential This system differentiates between 5 levels of impairment: *mildly impaired* (percentile range = 7 to 14); *mild-to-moderately impaired* (2nd to 5^{th} %ile); *moderately impaired* (0.6th to 1.9^{th} %ile); *moderately-to-severely impaired* (0.1st to 0.5^{th} %ile) and *severely impaired* (< 0.15^{th} %ile).

4.2. Guidelines for interpretation of normative data

The findings of this normative study have highlighted certain key principles that may be useful for the interpretation of cognitive test performance in the South African context.

Low scores do not necessarily indicate subnormal functioning: The study results were consistent with other normative studies which demonstrate that a certain percentage of typically developing individuals achieve low scores on cognitive tests, and that these scores do not necessarily indicate cognitive impairment (Brooks & Iverson, 2010; Brooks, Strauss, Sherman, Iverson, & Slick, 2009). It is thus important to acknowledge the fallibility of clinical cutoff points, and to assess an individual's neuropsychological performance in the context of as much other corroborating evidence as possible.

Cognitive tests differ according to levels of cultural bias: It is important to be aware of the potential for cultural bias when using cognitive tests that were designed and standardized for use in populations other than the test sample. However, the results of this study indicated a wide degree of variability in the extent to which the normative data for cognitive tests demonstrated bias against the local population. For example, local norms were equivalent to non-local norms for the entire sample for certain measures (e.g., ToL, and CLOX), but for other measures (e.g., CCTT, and GPT) for certain subgroups mean differences between the two norm sets were both statistically and clinically significant. The implications of these findings are that each cognitive measure should be evaluated in its own right, and interpretations of test performance should be based on observed findings rather than general assumptions.

Sociodemographic trends: Although I do not advocate the uniform adjustment of scores based on the assumptions about the sociodemographic profile of the test participant (without empirical evidence), the results of this study demonstrated some consistent trends with regard to the relative influences of sociodemographic variables on test performance. Where single main effects significantly affected cognitive outcome measures, without any exceptions, lowered scores were predicted by younger age, male sex, Afrikaans race, disadvantaged quality of education, and coloured race (for participants with advantaged quality of education).

For the cognitive measures predicted by multiple sociodemographic influences, sex and language were minimally influential, in contrast to quality of education and age. Without exception, quality of education exerted a stronger effect on neuropsychological performance than age.

There were also certain trends with regard to how pervasive the different sociodemographic effects were across the 34 cognitive measures. Quality of education was most pervasive, affecting 25/34 of subtest scores. Only one test (viz., ToL) was completely impervious to the effects of quality of education (i.e., there were no between-group differences in terms of quality of education on any of the ToL outcome variables). Almost two-thirds of the subtest scores (21/34) were significantly predicted by age, which was expected, in a sample of developing adolescents. Almost a quarter of the cognitive scores (8/34) were associated with language (viz., all Subtests from the CMS Numbers; Verbal Fluency Tests; and the WASI). Race was influential in 6/34 of the subtests, including CMS Numbers Forward, Semantic Fluency, and all four WASI subtests. The effects of sex were least pervasive, only affecting 5/34 of scores (viz., Clox Trial 2; ROCFT Time; WASI Similarities and Vocabulary Subtests; and Coding). Age was related to cognitive performance in 19/34 measures.

Age-related trends: The age-related variations in performance in this study are understandable in the context of the developing adolescent brain, and seem consistent with other neuroscientific information (P. Anderson, 2002; De Luca et al., 2003; Dennis, 2009; Sowell et al., 2004; Yurgelun-Todd, 2007). Overall findings indicate that the age-related improvement in performance across multiple measures tended to occur primarily after the age of 12. In all cases, better performances were demonstrated by the older adolescents. There also seemed to be a trend indicating a plateau of performance between the ages of 13 and 15. The performance gain rate seemed to stabilize or show more subtle improvements after the developmental leap at 12 years of age. Overall, the findings suggest that cognitive functioning continues to undergo refinements and becomes more efficient during the adolescent phase; these findings are consistent with demonstrations in other studies (Giedd et al., 2008; Gogtay et al., 2004; Luna, 2009; Shaw et al., 2006; Sowell et al., 2004; Yurgelun-Todd, 2007).

Interaction between quality of education, language, and race: Where language, race, and quality of education were all significantly associated with cognitive test performance, results showed trends toward a continuum of performance, from highest to lower scores, as follows: English-white-advantaged; Afrikaans-white-advantaged; English-coloured-advantaged; English-coloured-disadvantaged; Afrikaans-coloured-advantaged; and Afrikaans- coloured disadvantaged. This pattern was consistent with trends exhibited for adolescents from the Eastern Cape (Shuttleworth-Edwards et al., in press).

Quality of education is closely related to socioeconomic status, in this and other studies. The collective impact of socioeconomic adversity has been demonstrated to impact negatively on cognitive development in general (Bergen, 2008; G. A. Kaplan et al., 2001; S. Lee, Kawachi, Berkman, & Grodstein, 2003), and in language development in particular (Feagans, 1982). In future South African studies, it would be useful to examine the relationships between cognitive functioning and socioeconomic/educational deprivation, and factors that have been suggested to have an impact on the latter. Examples of factors worthy of further investigation are: reading ability (Bramao et al., 2007; Manly et al., 2004; Segerer et al., 2010; Shu, 2010; Wagner, 2010); hybrid language systems and usage; and bi-/multi-lingualism (Southwood & Van Dulm, 2009; Van Dulm & Southwood, 2008).

Uniform upward adjustment of scores: Practitioners sometimes compensate for socioeconomic or educational deprivation by adjusting patients' scores by adding a standard amount (e.g., 2 scaled scores or 1 SD, or by an IQ score). Case Study *B* demonstrated the interpretive pitfalls of the uniform upward adjustment of scores, due to the wide variability in cultural bias between different cognitive measures. The normative data from this study are helpful in this regard, because the data are appropriately stratified by the sociodemographic data, based on the statistical analyses. For the measures described in this study, no further adjustments are necessary if the tests are used for participants meeting the sociodemographic profile of the test population.

Nonverbal tests are not devoid of cultural bias: The results of this study confirm that nonverbal tests are not less prone to cultural bias than verbal tests. For example, local and non-local norms were remarkably similar (and devoid of cultural bias) for the MAVLT measures. By contrast, the CCTT Trial 1 measure was substantially biased against the local sample, regardless of quality of education. South African research demonstrating similar findings that non-verbal tests are not necessarily culture-fair has offered various possible explanations for the large differences in performance on nonverbal tests between groups with advantaged or disadvantaged quality of education. Grieve and Viljoen (2000) suggest that performance on cognitive tasks requiring non-verbal reasoning may be affected by education systems that emphasize rote learning rather than development of reasoning ability. Jinabhai et al. (Jinabhai et al., 2004) speculate that non-language tests may be more culturally loaded than language tests if the concepts and reasoning processes required to complete them are unfamiliar to the participants. Knoetze et al. (2005) explain that for matrix reasoning-type tests, for example, good performance is contingent on the development of analogical thinking.

Other African norms are not necessarily superior to non-African norms: The case studies and comparisons of study norms with other African normative data demonstrated that other African norms (e.g., Nampijja et al., 2010; Ruffieux et al., 2010) are not necessarily more suited to the Western Cape sample than norms from North America: Ugandan and Cameroonian norms were inappropriately lenient for our population, thereby increasing the risk of false negative misdiagnoses.

In summary, this doctoral study makes a contribution to the shortage of normative data for commonly-used cognitive tests within the field of psychometric testing. The study provides templates as examples of how to evaluate tests for cultural and linguistic bias, how to adapt the tests, how to evaluate the relative contribution of sociodemographic variables on test performance, how to evaluate the suitability of normative data for the test population; it also provides interpretive guidelines regarding the use of local and non-local normative data. The study further provides practical tools for practitioners to use, including translated test instructions, adapted test materials, and appropriately stratified normative data (in the form of descriptive data and normative conversion tables). It is hoped that these templates and tools may stimulate further attempts to redress the imbalance of supply and demand between the need for and the availability of appropriate normative data for commonly-used non-local tests in South Africa.

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Appendix A

Demographic Questionnaires

DEM – DEMOGRAFIESE VRAELYS (deelnemerselfverslag)

ALGEMENE INLIGTING

Volle name:				
Hoe sou jy jou ras beskryf?	1. Swart 2. Bruin 3. Wit			
	4. Asiaties 5. Ander (spesifiseer): 6. Weier om te antwoord			
Kontaknommers:	Persoon	Huis	Werk	Sel
	Self			
	Moeder			
	Vader			
	(Voog)			
Woonadres:				

OPVOEDING

Naam en gebied van huidige skool	Skool: Woongebied/gebied:

INLIGTING OOR WOONADRES

Hoe lank woon jy al by jou huidige adres?	
Hoe sal jy jou blyplek beskryf?	1. Plakkershut 2. Hout tuinhuisie of agterplaaswoning 3. Tent of tradisionele woning 4. Woonstel 5. Dorpshuis/semi-losstaande huis 6. Losstaande steenhuis 7. Ander (spesifiseer):
Watter van die volgende dinge het julle in die huis? (merk soveel as nodig)	A. Kraanwater B. Spoeltoilet in die huis C. Elektrisiteit D. Telefoon (landlyn) E. Televisie F. Rekenaar G. Motor
Hoeveel mense slaap saans in dieselfde vertrek as jy wanneer jy tuis is?	1. een 2. twee 3. drie 4.vier 5. vyf 6. meer as vyf 7. geen

GESINSINLIGTING

<table>
<tr><td colspan="2">Wie is jou primêre sorggewer?
(Beskryf die verhouding, byvoorbeeld ma, pa, tannie ens.)</td><td></td></tr>
<tr><td colspan="2">As jou ma of pa nie jou primêre sorggewers is nie, hoe oud is jou voog?</td><td></td></tr>
<tr><td colspan="2">Wat is jou verhouding met jou BIOLOGIESE MOEDER?</td><td>1. onbekend 2. bekend, maar ongereelde kontak
3. bekend en gereelde kontak 4. bly saam met kind
5. oorlede</td></tr>
<tr><td colspan="2">Hoe oud is sy? (Indien oorlede, gee ouderdom en rede vir afsterwe)</td><td></td></tr>
<tr><td colspan="2">Wat is jou verhouding met jou BIOLOGIESE VADER?</td><td>1. onbekend 2. bekend, maar ongereelde kontak
3. bekend en gereelde kontak 4. bly saam met kind
5. oorlede</td></tr>
<tr><td colspan="2">Hoe oud is hy? (Indien oorlede, gee ouderdom en rede vir afsterwe)</td><td></td></tr>
<tr><td colspan="2">Wat is jou ouers se huwelikstatus?</td><td>1. getroud 2. bly saam 3. weduwee/wewenaar
4. geskei en woon apart 5. geskei en woon saam
6. uitmekaar 7. weer getroud
8. ander (spesifiseer):</td></tr>
<tr><td rowspan="5">Woon jy saam met iemand wat ’n huidige alkoholprobleem het of dwelms gebruik?</td><td>1. Nee</td><td>2. Ja</td></tr>
<tr><td>Spesifiseer verhouding</td><td>Spesifiseer middel(s) wat misbruik word</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td rowspan="5">Woon jy saam met enigiemand wat in die verlede ’n alkoholprobleem gehad het of dwelmmiddels gebruik het?</td><td>1. Nee</td><td>2. Ja</td></tr>
<tr><td>Spesifiseer verhouding</td><td>Spesifiseer middel(s) wat misbruik is</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
</table>

DEM – DEMOGRAPHIC QUESTIONNAIRE (participant self-report)

GENERAL INFORMATION

Full name:				
How would you describe your race?	1. Black	2. Coloured		3. White
	4. Asian	5. Other(specify):		6. Refuse to answer
Contact numbers:	Person	Home	Work	Cel
	Self			
	Mother			
	Father			
	(Guardian)			
Residential Address:				

EDUCATION

Name and area of Current School:	School: Suburb / area:

RESIDENTIAL INFORMATION

How long have you lived at your current address?	
How would you describe your dwelling?	1. Shack 2. Wendy house or backyard dwelling 3. Tent or traditional dwelling 4. Flat / apartment 5. Town house / semi-detached house 6. Freestanding brick house 7. Other (specify):
Which of these items do you have in your home? (mark as many as necessary)	A. Tap water B. Flush toilet inside home C. Electricity D. Telephone (landline) E. Television F. Computer G. Car
How many people sleep in the same room with you at night when you are at home?	1. one 2. two 3. three 4. four 5. five 6. more than five 7. none

FAMILIAL INFORMATION

Who is your primary care-giver? (Describe the relationship, e.g. mother, father, uncle etc.)	
What is your relationship with your **BIOLOGICAL MOTHER**?	1. Unknown 2.Known, but irregular contact 3. Known and regular contact 4. Living with child 5. Deceased
How old is she? (If deceased, specify age and reason of death)	
What is your relationship with your **BIOLOGICAL FATHER**?	1. Unknown 2.Known, but irregular contact 3. Known and regular contact 4. Living with child 5. Deceased
How old is he? (If deceased, specify age and reason of death)	
What is your parents' marital status?	1. married 2. co-habiting 3. widowed 4. divorced & living apart 5. divorced & living together 6. separated 7. remarried 8. other (specify):

Do you live with anyone that has a current alcohol problem or uses drugs?	1. No	2. Yes
	Specify relationship	Specify substance/s abused
Do you live with anyone that used to have an alcohol problem or used drugs in the past?	1. No	2. Yes
	Specify relationship	Specify substance/s abused

PAR – ONDERHOUD MET OUER (AFGENEEM DEUR KLINIKUS of SELFVERSLAG)

INLIGTING OOR OUER:

Volle name:			
Verwantskap aan kind:	1. Moeder 2. Vader 3. Ouma 4. Oupa 5. Voog 6. Ander (spesifiseer):		
Kontaknommers:	Huis:	Werk:	Sel:
Huwelikstatus:	1. getroud 2. woon saam 3. weduwee of wewenaar 4. geskei en woon apart 5. geskei en woon saam 6. uitmekaar 7. weer getroud 8. ander (spesifiseer):		
Gekombineerde inkomste van huishouding (voor belastingaftrekkings) PER JAAR	1. Minder as R10 000 2. R10 000–20 000 3. R20 000–40 000 4. R40 000–60 000 5. R60 000–R100 000 6. Meer as R100 000		

INLIGTING OOR OUERS SE WERK:

Wat is jou beroep? (byvoorbeeld onderwyser, professor, werkloos, student)	
Wat is jou kind se ander ouer / voog se beroep?	

ONTWIKKELINGSMYLPALE (KIND):

Hoe oud was u kind toe hy of sy die volgende vir die eerste keer gedoen het?		
sit	5–8 maande	ouer as 9 maande
kruip	7–9 maande	ouer as 10 maande
loop	11–15 maande	ouer as 16 maande
eerste woorde gepraat	10–15 maande	ouer as 16 maande
in kort sinnetjies gepraat	18–24 maande	ouer as 2 jaar
in volsinne gepraat	3–4 jaar	ouer as 4 jaar

OUER SE OPVOEDING:

Hoogste vlak van onderwys voltooi	Moeder	Vader	Voog
Merk een antwoord op elk van die onderstaande vrae vir elke persoon:			
1. 0 jare (Geen grade of standerds) = Geen formele onderwys (nooit skoolgegaan)	1.	1.	1.
2. 1-6 jaar (Graad 1-6 / Sub A-St 4) = minder as laeronderwys (het laerskoolopleiding nie voltooi nie)	2.	2.	2.
3. 7 jaar (Graad 7 / St 5) = Laer onderwys (laerskoolopleiding voltooi)	3.	3.	3.
4. 8-11 jaar (Graad 8-11 / St 6-9) = 'n deel van sekondêre onderwys (het sekondêre opleiding nie voltooi nie)	4.	4.	4.
5. 12 jaar (Graad 12 / St 10) = Sekondêre onderwys (het sekondêre opleiding voltooi)	5.	5.	5.
6. 13+ jaar = Tersiêre onderwys (universiteits-/ technikon-/ kollege-opleiding voltooi)	6.	6.	6.
7. Weet nie	7.	7.	7.

PAR – PARENT INTERVIEW (CLINICIAN ADMINISTERED or SELF-REPORT)

PARENT INFORMATION:

Full name:			
Relationship to child:	1. Mother 2. Father 3. Grandmother 4. Grandfather 5. Guardian 6. Other (specify):		
Contact numbers:	Home:	Work:	Cel:
Marital status:	1. married 2. co-habiting 3. widowed 4. divorced & living apart 5. divorced & living together 6. separated 7. remarried 8. other (specify):		
Combined household income (before tax deductions) PER YEAR	1. Less than R10 000 2. R10 000 – 20 000 3. R20 000 – 40 000 4. R40 000 – 60 000 5. R60 000 – R100 000 6. More than R100 000		

PARENTAL EMPLOYMENT:

What do you do for a living? (e.g. teacher, professor, unemployed, student)	
What does your child's other parent / caregiver do for a living?	

DEVELOPMENTAL MILESTONES (CHILD):

How old was your child when they did the following tasks for the first time?		
sitting	5 – 8 months	older than 9 months
crawling	7 – 9 months	older than 10 months
walking	11 – 15 months	older than 16 months
first words spoken	10 – 15 months	older than 16 months
speaking in short sentences	18 – 24 months	older than 2 years
speaking in full sentences	3 – 4 years	older than 4 years

PARENTAL EDUCATION:

Highest level of education reached?	Mother	Father	Guardian
Mark one response for each person as follows:			
1. 0 years (No Grades / Standards) = No formal education (never went to school)	1.	1.	1.
2. 1-6 years (Grades 1-6 / Sub A-Std 4) = Less than primary education (didn't complete primary school)	2.	2.	2.
3. 7 years (Grade 7 / Std 5) = Primary education (completed primary school)	3.	3.	3.
4. 8-11 years (Grades 8-11 / Stds 6-9) = Some secondary education (didn't complete high school)	4.	4.	4.
5. 12 years (Grade 12 / Std 10) = Secondary education (completed senior school)	5.	5.	5.
6. 13+ years = Tertiary education (completed university / technikon / college)	6.	6.	6.
7. Don't know	7.	7.	7.

Appendix B

Figures Demonstrating Relationships between Socioeconomic Status and Quality of Education

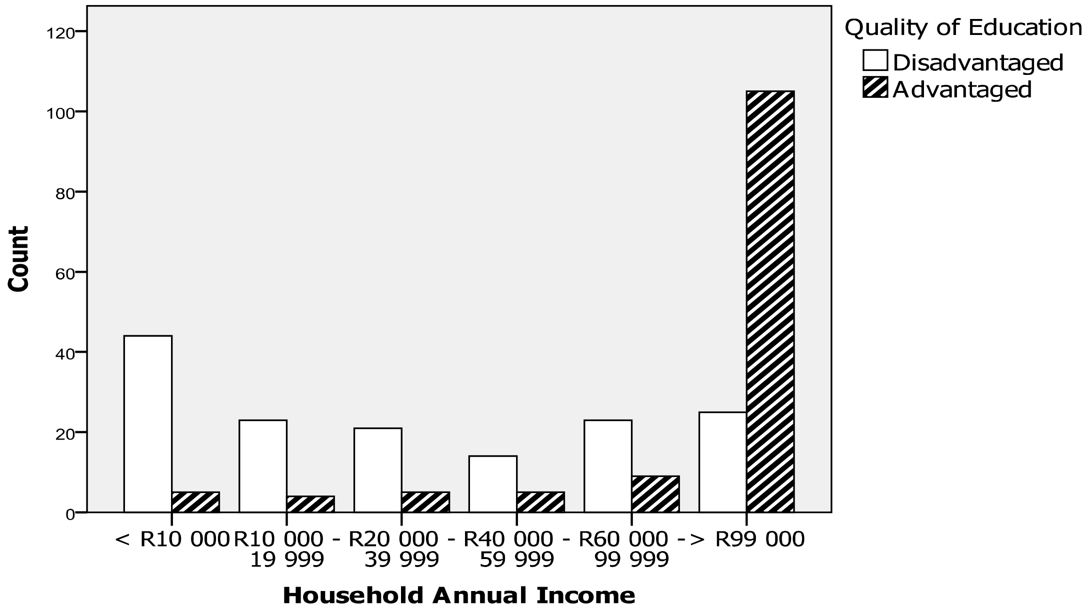

Figure B-1. Relationship between quality of education and household income.

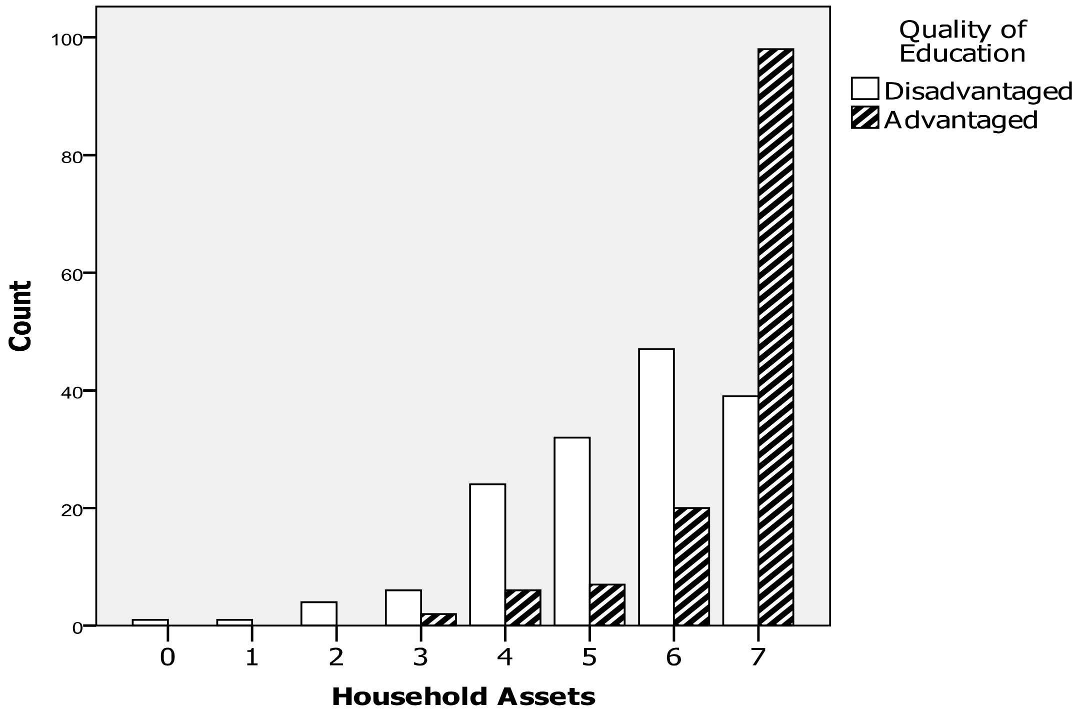

Figure B-2. Relationship between quality of education and household assets.

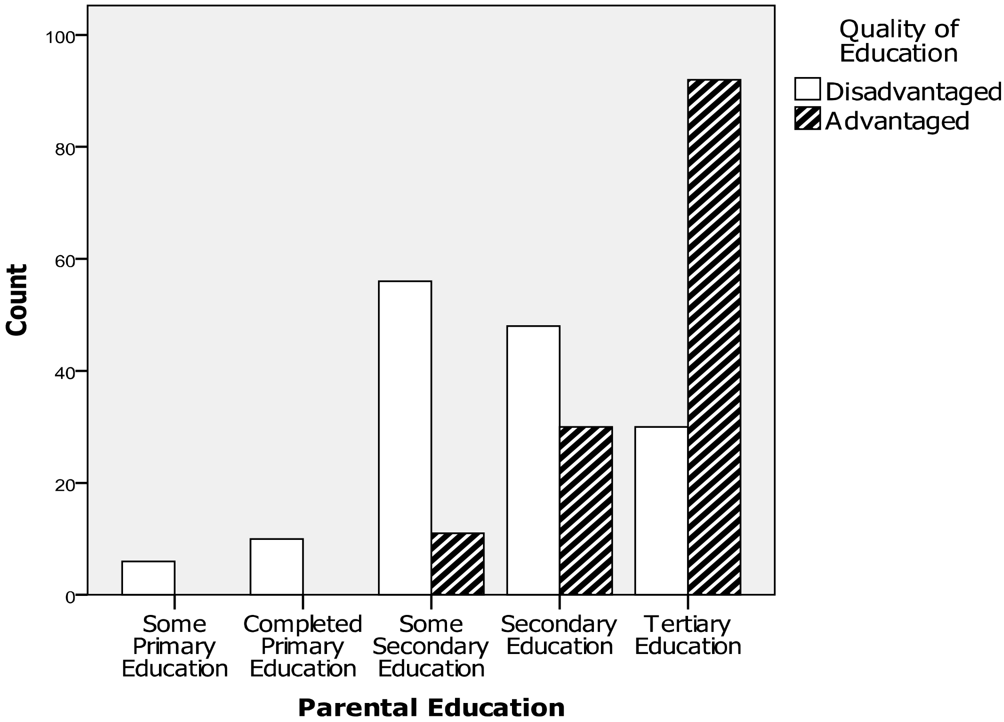

Figure B-3. Relationship between quality of education and parental education.

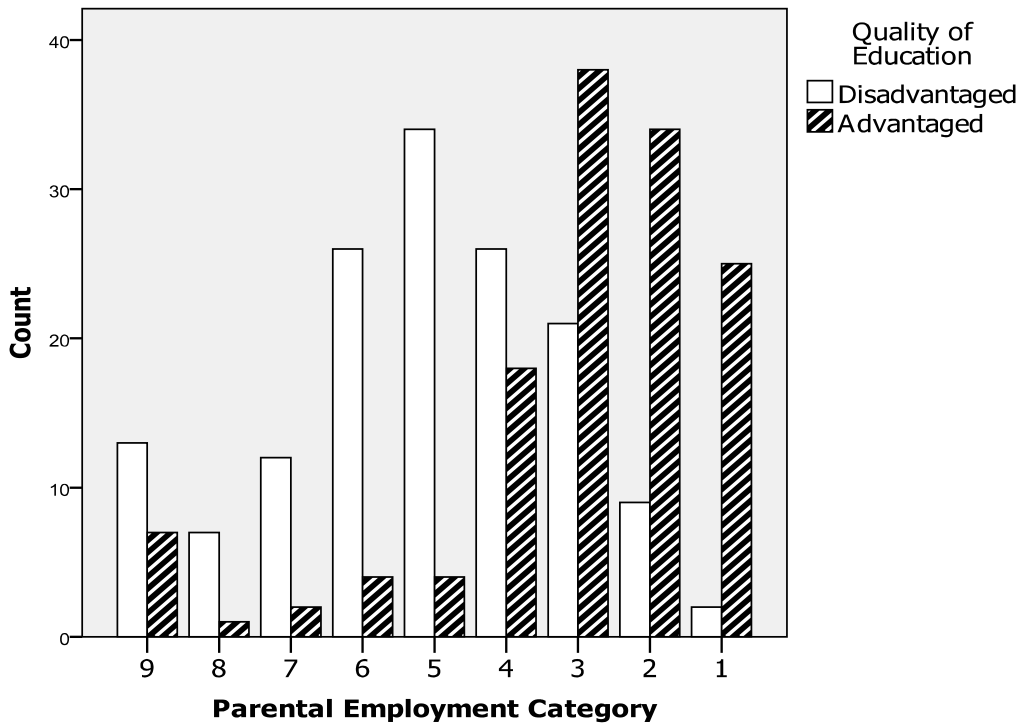

Figure B-4. Relationship between quality of education and parental employment.

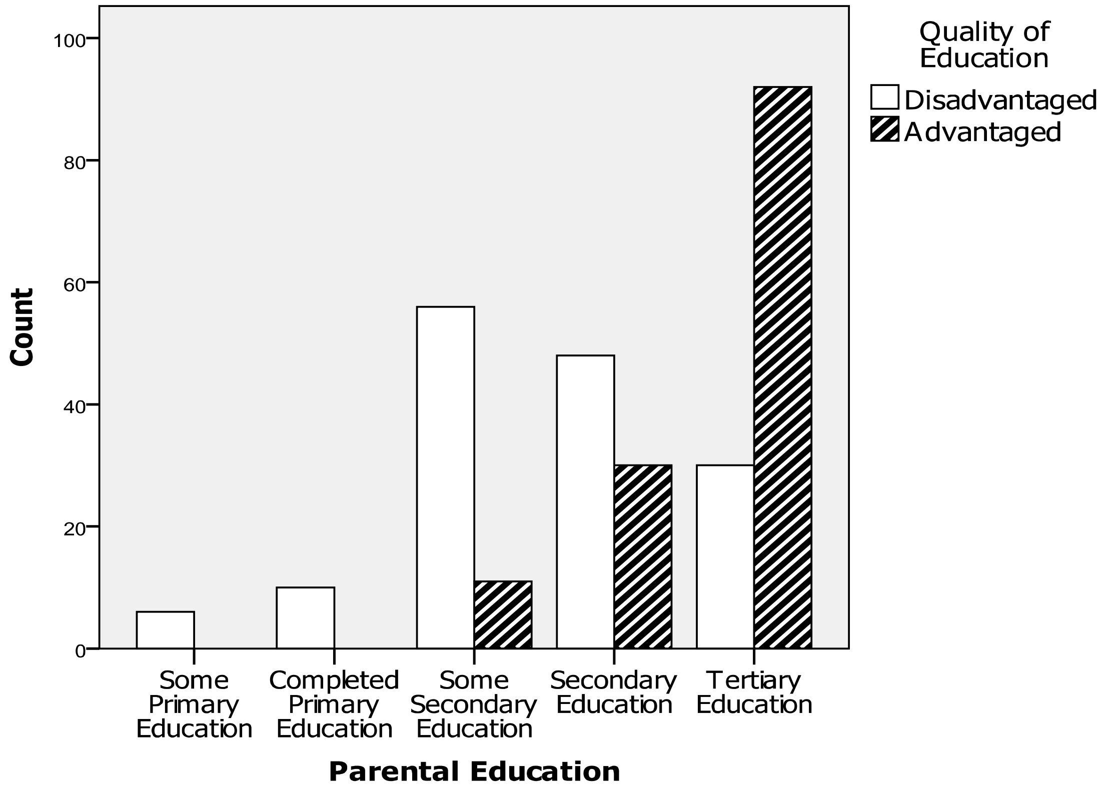

Figure B-5. Relationship between quality of education and parental education.

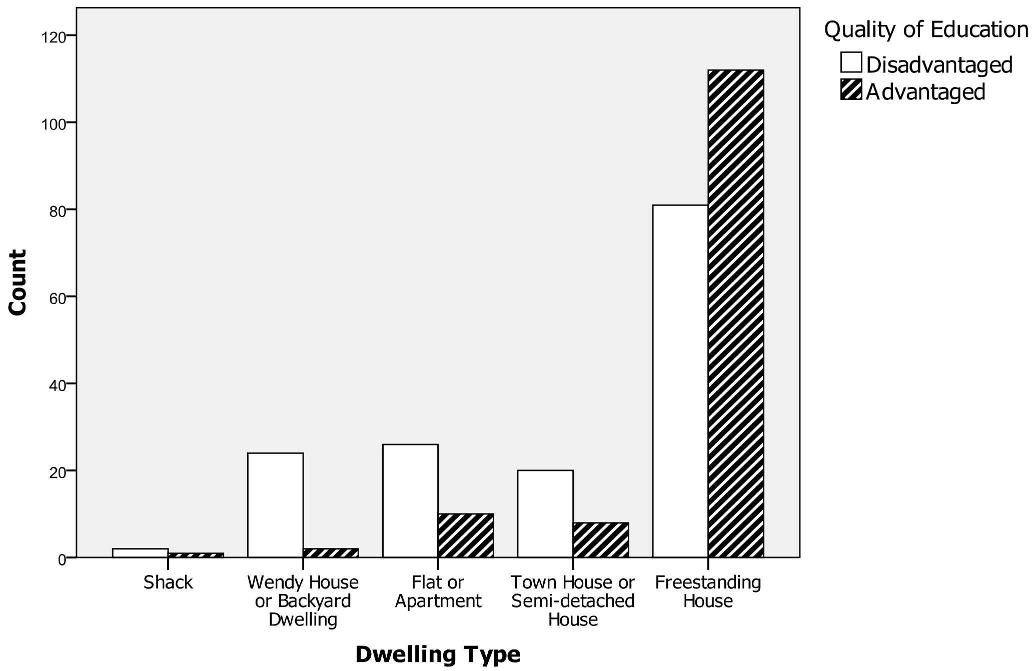

Figure B-6. Relationship between quality of education and dwelling type.

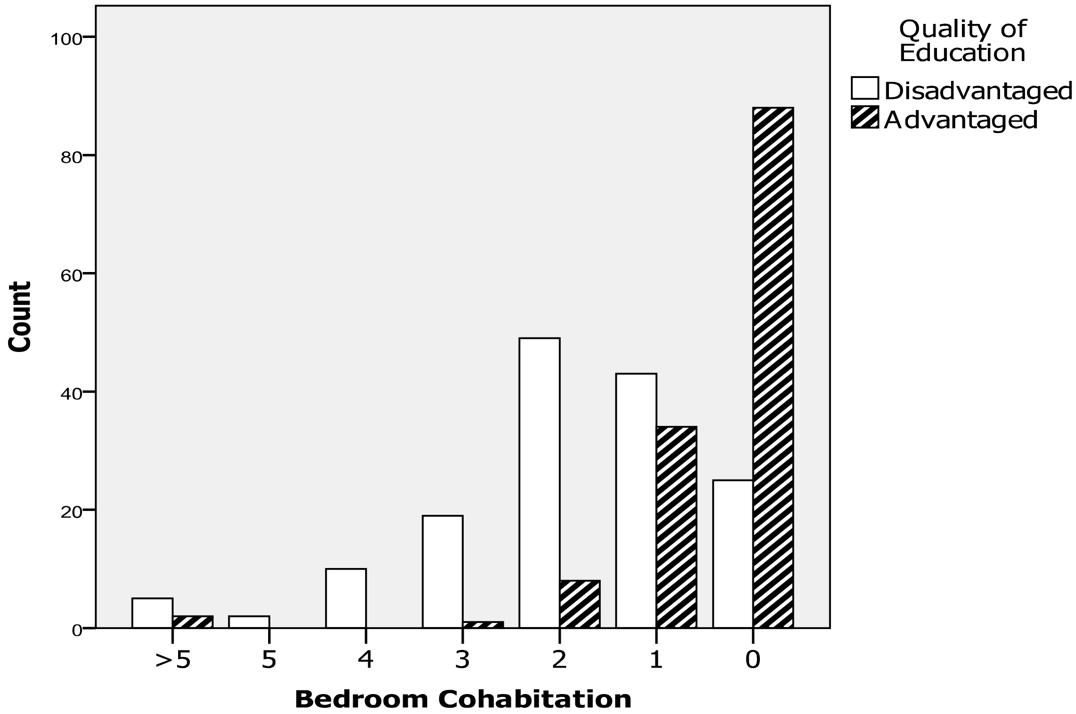

Figure B-7. Relationship between quality of education and bedroom cohabitation.

Appendix C

Test Instructions in Afrikaans and English

CCTT: English instructions

CCTT Trial 1 Pretest: Please count aloud from 1 to 15.

CCTT Trial 1 Practice: In this box are different colored circles with numbers in them. When I say BEGIN, I want you to take this pencil and connect the circles by going from 1 to 2 to 3 and so on, until you reach the number 8. I want you to connect the circles as fast as you can without lifting the pencil off the paper. If you make a mistake, I will tell you. When I do, I want you to move the pencil to the last correct circle and continue from there. The line that you draw must touch the circles in the correct order. Do you have any questions? Okay, let's practice (give pencil). Put your pencil here where the hand is telling you to start. When I say BEGIN, connect the circles in order as fast as you can, until you reach the number 8 next to the hand telling you to stop. Ready? BEGIN.

CCTT Trial 1: Now I have a sheet with a lot more numbers and circles. Connect the circles just like you did a minute ago. Again, work as fast as you can, and do not lift the pencil off the paper as you go. Make sure that your lines touch the circles. You will start here where the hand tells you to start, and end where the hand tells you to stop. Ready? BEGIN.

CCTT Trial 2 Practice: In this box are different colored circles with numbers in them. This time, I want you to take the pencil and connect the circles in order by going from this color 1, to this color 2, to this color 3, and so on, until you get to the last number next to the hand telling you to stop. Notice that the color changes each time you go to the next number. I want you to work as fast as you can. Don't lift the pencil off the paper once you've started. If you make a mistake, I will tell you. When I do, I want you to move the pencil to the last correct circle and continue from there. Just like before, the line you draw must touch the circles in the correct order. Do you have any questions? Okay, let's practice. Put your pencil here next to the hand telling you to start. When I say BEGIN, connect the circles in order as fast as you can, changing from one color to the next, until you get to the hand telling you to stop. Ready? BEGIN.

CCTT Trial 2: Now I have a sheet with a lot more numbers and colored circles. Connect the circles just like you did a minute ago. Again, work as fast as you can. You will start here where the hand is telling you to start, and end where the hand is telling you to stop. Ready? BEGIN.

CCTT: Afrikaans Instructions

CCTT Trial 1 Pretest: Tel asseblief hardop van 1 tot 15.

CCTT Trial 1 Practice: In hierdie raam is verskillend keure sirkels met 'n nommer in elkeen. Wanneer ek sê BEGIN, wil ek hê hy moet hierdie potlood neem en die sirkels verbind deur van 1 na 2 na 3 ensovoorts te beweeg totdat jy by nommer 8 kom. Ek will hê jy moet die sirkels so vinning moontlik verbind sonder om die potlood van die papier af op te lig. As jy 'n fout maak, sal ek vir jou sê. As jy wél 'n fout maak, wil ek hê jy moet die potlood terugneem na die vorige korrekte sirkel en van daar af voortgaan. Die lyn wat jy trek, moet die sirkels in die regte volgorde raak. Het jy enige vrae? Goed, kom ons oefen eers (give pencil). Sit jou potlood hier neer waar die hand vir jou wys jy moet begin. Wanneer ek sê BEGIN, verbind die sirkels in die regte volgorde so vinnig as wat jy kan, totdat jy kom y sirkel nommer 8 langs die hand wat vir jou sê waar jy moet eindig. Gereed? Begin.

CCTT Trial 1: Nou het ek 'n vel papier met baie meer nommers en sirkels daarop. Verbind die sirkels presies soos jy dit nou net gedoen het. Werk weer so vinnig as wat jy kan, en moenie die potlood van die papier af oplig terwyl jy met die opdrag besig is nie. Maak seker jou lyn raak aan die sirkels. Jy gaan hier begin waar die hand vir jou wys om te begin, en eindig waar die hand vir jou wys jy moet eindig. Gereed? BEGIN.

CCTT Trial 2 Practice: In hierdie raam is verskillende Kleure sirkels met 'n nommer in elkeen. Hierdie keer wil ek hê jy moet die potlood neem en die sirkels in volgorde verbind deur te beweeg van hierdie kleur 1, no hierdie kleur 2, na hierdie kleur 3, ensovoorts, totdat jy by die laaste nommer kom langs die hand wat vir jou sê waar jy moet eindig. Let op dat die kleur verander elke keer wanneer jy na die volgende nommer beweeg. Ek wil hê jy moet so vinnig as moontlik werk. Moenie die potlood van die papier af oplig as jy eers begin het nie. As jy 'n fout maak, sal ek vir jou sê. As jy wél 'n fout maak, wil ek hê jy moet die potlood terugneem na die laaste regte sirkel en van daar af voortgaan met die opdrag. Net soos voorheen, moet die lyn wat jy trek die sirkels in die regte volgorde raak. Het jy enige vrae? Goed, kom ons oefen eers. Sit jou potlood hier langs die hand wat vir jou wys waar jy moet begin. Wanneer ek sê BEGIN, verbind die sirkels in volgorde so vinnig as wat jy kan en verander van die een kleur na die volgende totdat jy by die hand kom wat vir jou wys waar jy kan ophou. Gereed? BEGIN.
CCTT Trial 2: Nou het ek 'n vel papier met baie meer nommers en gekleurde sirkels op. Verbind die sirkels presies soos jy dit nou net gedoen het. Werk weer so vinnig as wat jy kan.

Jy kan begin waar die hand vir jou wys jy kan begin, en eindig waar die hand vir jou wys jy moet eindig. Gereed? BEGIN.

CMS Numbers: English instructions

Numbers Forward: [Say]: I'm going to say some numbers. Listen carefully, and when I'm finished, you say them in the order as I said them. For example, if I say 4, 8, you say 4, 8.

Numbers Backward : [Say]: Now I'm going to say some numbers, but this time when I stop, I want you to say them backward. For example, if I say 5, 9, you say… [9, 5].

CMS Numbers: Afrikaans instructions

Numbers Forward): [Say]: Ek gaan vir jou 'n paar getalle opnoem. Luister goed, want wanneer ek klaar is, moet jy vir my die getalle herhaal in dieselfde volgorde as wat ek hulle gesê het. Byvoorbeeld, as ek sê 4, 8, sê jy 4, 8.

Numbers Backward: [Say]: Nou gaan ek 'n paar getalle sê, maar wanneer ek hierdie keer klaar is, wil ek hê jy moet hulle vir my in omgekeerde volgorde opsê. Byvoorbeeld, wanneer ek sê 5,9, jy sê … [9, 5].

CMS Stories: English instructions

Immediate Recall: [Say]: I'm going to read a short story to you. Listen very carefully, and try to remember as much of the story as you can. When I'm finished, I want you to tell me the story exactly the way I read it. Do you understand? [Read story then say]: Now tell me the story. Start at the beginning and try not to leave anything out.

Story E: Over two hundred years ago, the first hot air balloon was built in England. The balloon was made of paper covered with cloth to make it stronger. A large basket made of straw and weighing 20 kilograms was attached to it with cables. A long rope anchored the balloon to the ground. On the first flight, the pilot was in the air for 15 minutes. Later he took a friend, and they stayed up for one hour. They travelled 100 kilometres before landing in a treetop on the side of a hill.

Story F: In the 1700s, large herds of buffalo roamed the plains of America. Many Native American tribes, like the Sioux and the Blackfoot, followed the herds to survive. They hunted on horseback, killing the buffalo with bows and arrows. They used the meat for food, the bones for tools, and the skins for clothing. During the 1800s, the buffalo were killed in large numbers for sport and money by settlers from the East. Soon the buffalo had vanished, and the Native Americans lost their largest food source.

[After recording the examinee's response, say]: I want you to remember both stories because I'm going to ask you to tell them to me again later on.

Delayed Recall: [Say]: Remember the story I read to you about the ballon/Native Americans? I want you to tell me the story one more time. If you can't remember the whole story, try to tell me as much as you can remember. Now tell me the story. Start at the beginning and try not to leave anything out.

Recognition (Story E): I'm going to ask you some questions about the balloon story. If you're not sure of an answer, it's okay to guess.

1. Is this story about the first flying hot air balloon?
2. Did the story take place in England?
3. Did this story take place over 300 years ago?
4. Was the balloon made out of rubber?
5. Was the balloon covered with cloth to make it stronger?
6. Was the basket made out of wood?
7. Did the basket weigh 15 kilograms?
8. Was the basket attached with cables?
9. Was the balloon anchored to the ground for the first flight?
10. On the first trip, did the pilot stay up 10 minutes?
11. Did the pilot later take his friend in the balloon?
12. Did the pilot stay up 2 hours with his friend?
13. Did they travel 100 kilometres?
14. Did they land in a treetop on the side of a hill?
15. Were flying balloons common at that time?

Recognition (Story F): Now I'm going to ask you some questions about the Native American story. If you're not sure of an answer, it's okay to guess.

16. Did this story happen in the 1600s?
17. Did the story take place in Canada?
18. Did the Sioux follow the buffalo?
19. Were the Native American tribes following the herds to survive?
20. Did the Blackfoot also follow the herds of buffalo?
21. Did the Native American hunt the buffalo with guns?
22. Did the Native Americans use the buffalo bones for tools?
23. Were clothes made from the skins?
24. Does the story say the buffalo were killed in large numbers in the 1700s?
25. Did the settlers kill large numbers of buffalo?
26. Were the settlers from the West?
27. Did the settlers kill the buffalo only for food?
28. Did the settlers from the East kill the buffalo mainly for sport and money?
29. Did the settlers sell the buffalo robes to the Native Americans?
30. Were the buffalo the Native Americans' largest source of food?

CMS Stories: Afrikaans instructions

Immediate Recall: Ek gaan vir jou 'n kort storie lees. Luister baie mooi, en Probeer die storie so goed as wat jy kan onthou. Wanneer ek klaar gelees het, wil ek hê jy moet vir my die storie vertel presies soos ek dit gelees het. Verstaan jy? [Read story then say]: Vertel nou vir my die storie. Begin by die begin, en Probeer om niks uit te laat nie.

Story E: Meer as twee honderd jaar gelede, is die eerste warmlugballon in Engeland gebou. Die lugballon is gemaak van papier wat met material oorgetrek is om dit sterker te maak. A groot mandjie, van strooi gemaak en twintig kilogram swaar, is met kabels daaraan vasgemaak. 'n Lang tou het die ballon aan die grond geanker. Met die eerste vlug, was die vlieënier vyftien minute lank in die lug. Later het hy 'n vriend saamgeneem en hulle het 'n huur lank bo gebly. Hulle het 'n honderd kilometer gereis voordat hulle in 'n boomtop teen die hange van 'n heuwel geland het.

Story F: In die sewentienhonderd's het groot troppe buffels oor die vlaktes van Amerika geswerf. Baie inheemse Amerikaanse stamme, soos die Sioux en die Blackfoot, het die troppe gevolg om te oorleef. Hulle het te perd gejag, en die buffels met 'n pyl en boog doodgemaak.

Hulle het die vleis vir kos gebruik, die bene vir gereedskap, en die velle vir klere. Gedurende die agtienhonderd's, is die buffels in groot getalle doodgemaak vir sport en geld deur nedersetters uit die Ooste. Kort-voor-lank het die buffels verdwyn, en die inheemse Amerikaanse mense het hulle grootste voedselbron verloor.

[After recording the examinee's response, say]: Ek wil hê jy moet albei stories onthou, want ek gaan jou later vra om hulle weer vir my te vertel.

Delayed Recall: [Say]: Onthou jy die storie oor die warmlugballon wat ek vir jou gelees het? Ek wil hê jy moet die storie nog een keer vir my vertel. As jy dalk dele van die storie vergeet het, Probeer net om vir my alles te vertel wat jy wel kan onthou. Vertel nou vir my dis storie. Begin by die begin, en Probeer om niks uit te laat nie.

Recognition (Story E): Ek gaan vir jou 'n paar vrae oor die warmlugballon-storie vra. As jy nie seker is van 'n antwoord nie, mag jy raai.

1. Is hierdie storie oor die eerste vlieënde warmlugballon?
2. Het die storie in Engeland afgespeel?
3. Het hierdie storie meer as drie honderd jaar gelede plaasgevind?
4. Was die ballon van rubber gemaak?
5. Was die ballon met materiaal oorgetrek om dit sterker te maak?
6. Was die mandjie van hout gemaak?
7. Het die mandjie vfytien kilogram geweeg?
8. Was die mandjie met kabels vasgemaak?
9. Was die ballon aan die grond geanker vir die eerste vlug?
10. Het die vlieënier met die eerste vlug tien minute in die lug gebly?
11. Het die vlieënier later sy vriend in die ballon saamgeneem?
12. Het die vlieënier twee uur bo gebly saam met sy vriend?
13. Het hulle 'n honderd kilometer gevlieg?
14. Het hulle in 'n boomtop teen die hange van 'n heuwel geland?
15. Was vlieënde ballonne algemeen in daardie tyd?

Recognition: Ek gaan vir jou ’n paar vrae oor die storie van die inheemse Amerikaanse mense vra. As jy nie seker is van ’n antwoord nie, mag jy raai.

16. Het hierdie storie in die sestienhonderd’s gebeur?
17. Het die storie in Kanada afgespeel?
18. Het die Sioux die buffels gevolg?
19. Het die inheemse Amerikaanse stamme die troppe gevolg om te oorleef?
20. Het die Blackfoot ook die troppe buffels gevolg?
21. Het die inheemse Amerikaanse mense die buffels met gewere gejag?
22. Het die Amerikaanse mense die buffels se bene vir gereedskap gebruik?
23. Is klere van die velle gemaak?
24. Sê die storie buffels is in groot getalle in die sewentienhonderd’s doodgemaak?
25. Het die nedersetters baie buffels doodgemaak?
26. Was die nedersetters uit die Weste?
27. Het die nedersetters die buffels net vir kos doodgemaak?
28. Het die nedersetters uit die ooste die buffels hoofsaaklik vir sport en geld doodgemaak?
29. Het die nedersetters die buffelvelklere aan die inheemse Amerikaanse mense verkoop?
30. Was die buffels die inheemse Amerikaanse mense se grootste bron van voedsel?

CLOX: English instructions

CLOX Trial 1: [Expose page with circle visible from page underneath and say]: Draw me a clock that says one: forty-five. Set the hands and numbers on the face so that a child could read them.

CLOX Trial 2: [Expose page with printed circle template and say]: Watch me. [Demonstrate clock drawing on template. Place 12, 6, 3 and 9 first; fill in all other numbers; place hands correctly; ensure hands have arrows; ensure that the hour hand is shorter than the minute hand. Say]: Copy this one [show] over here [show].

CLOX: Afrikaans instructions

CLOX Trial 1: [Expose page with circle visible from page underneath and say]: Teken vir my ‘n horlosie wat sê een: vyf-en-veertig. Stel die hande en nommers op die gesig sodat ‘n kind hulle sou kan lees.

CLOX Trial 2: [Expose page with printed circle template and say]: Hou my dop. [Demonstrate clock drawing on template. Place 12, 6, 3 and 9 first; fill in all other numbers; place hands correctly; ensure hands have arrows; ensure that the hour hand is shorter than the minute hand. Say]: Teken hierdie een oor [show] here [show].

EHI: English instructions

Please indicate for each of the activities below whether you always use your left hand, usually use your left hand, have no preference, usually use your right hand, or always use your right hand. [Items]: writing; drawing; throwing; cutting with scissors; brushing teeth; holding a knife to cut meat; using a spoon; striking a match; opening a box lid; kicking a ball.

EHI: Afrikaans instructions

Dui asseblief vir elke aktiwiteit hieronder aan of jy altyd jou linkerhand gebruik, gewoonlik jou linkerhand gebruik, geen voorkeur het nie, gewoonlik jou regterhand gebruik, of altyd jou regterhand gebruik. [Items]: skryf; teken; gooi; knip met 'n skêr; tande borsel; 'n mes vashou om vleis te sny; 'n lepel gebruik; 'n vuurhoutjie trek; 'n boks se deksel oopmaak; 'n bal skop.

GPT: English instructions

Peg Insertion (GPT 1) Dominant Hand: This is a pegboard and these are the pegs [show]. All the pegs are the same. They have a round side and a square side and so do the holes in the board [show]. What you must do is match the groove of the peg with the groove of the board and put these pegs into the holes like this [demonstrate by filling the top row, then return the pegs to the tray]. When I say BEGIN, start here [show] and put the pegs into the board as fast as you can. Use only your [dominant] hand. Fill the rows completely from this side to this side [show]. Do not skip any. Fill each row the same way you filled the top row. Any questions? Ready, as fast as you can, BEGIN.

Peg Removal (GPT 2) Dominant Hand: Now you must remove all the pegs. Start here [show] and take the pegs out one by one until the board is empty. Any questions? Ready, as fast as you can, BEGIN.

Peg Insertion (GPT 1) Nondominant Hand: Now you must place the pegs in the grooves again using only your [non-dominant] hand. Fill the rows completely from this side to this side [show]. Do not skip any. Fill each row the same way you filled the top row. Any questions? Ready, as fast as you can, BEGIN.

Peg Removal (GPT 2) Nondominant Hand: Now you must please remove all the pegs. Start here [show] and take the pegs out one by one until the board is empty. Any questions? Ready, as fast as you can, BEGIN.

GPT: Afrikaans instructions

Peg Insertion (GPT 1) Dominant Hand: Hierdie is 'n gaatjiesbord en hierdie is die pennetjies [show]. Al die pennetjies is dieselfde. Hulle het 'n groef (of ronde kant) en 'n vierkantige kant en so ook die gaatjies in die bord [show]. Wat jy moet doen, is om die groef van die pennetjie in die groef van die bord te laat pas en hierdie pennetjies so in die gaatjies te sit [demonstrate by filling the top row, then return the pegs to the tray]. Wanneer ek sê BEGIN, begin hier [show] en sit die pennetjies so gou as wat jy kan in die bord. Gebruik net jou [dominant] hand. Maak die boonste ry van kant tot kant vol [show]. Moet nie een uitlaat nie. Maak elke ry vol dieselfde as jy die boonste ry voltooi het. Enige vrae? Gereed, so gou jy kan, BEGIN.

Peg Removal (GPT 2) Dominant Hand: Now moet jy die pennetjies uithaal. Begin hier [show] en neem die pennetjies uit een vir een totdat die bord leeg is. Enige vrae? Reg, so vinning as jy kan, BEGIN.

Peg Insertion (GPT 1) Nondominant Hand: Nou moet jy die pennetjies eer in die gaatjies sit. Gebruik net jou [non-dominant]) hand. Maak die boonste ry heeltemal van kant tot kant vol [show]. Moet nie een uitlaat nie. Maak elke ry vol dieselfde as jy die boonste ry voltooi het. Enige vrae? Gereed, so gou jy kan, BEGIN.

Peg Removal (GPT 2) Nondominant Hand: Nou moet jy asseblief die pennetjies uithaal. Begin hier [show] en neem die pennetjies uit een vir een totdat die bord leeg is. Enige vrae? Reg, so vinning as jy kan, BEGIN.

MAVLT: English instructions

Trial 1: I'm going to read you a list of words. Listen carefully, for when I stop you are to repeat back as many words as you can remember. It doesn't matter in what order you say them. Just say as many words as you can remember: arm, cat, axe, bed, plane, ear, dog, hammer, chair, car, eye, horse, knife, clock, bike.

Trial 2 through to Trial 5: Now I am going to read the same words again. Once again, when I stop I want you to tell me as many words as you can remember, including words you said the first time. It doesn't matter in what order you say them. Just say as many words as you can remember: arm, cat, axe, bed, plane, ear, dog, hammer, chair, car, eye, horse, knife, clock, bike.

List B: Now I'm going to read you a second list of words. Listen carefully, for when I stop you are to repeat back as many words as you can remember: shoe, monkey, plate, cow, finger, dress, spider, cup, bee, foot, hat, butterfly, kettle, mouse, hand.

Immediate Recall: Now tell me all the words that you can remember from the first list.

Delayed Recall: A while ago, I read a list of words to you several times and you had to repeat back the words. Tell me all the words that you can remember from that list.

Recognition: I will say some words that were on the first list that I read to you, and some words that were not on that list. Each time I read a word, tell me if it was on that list or not.

MAVLT: Afrikaans instructions

Trial 1: Ek gaan vir jou 'n lys woorde lees. Luister goed, want wanneer ek klaar is, jy moet soveel van die woorde as wat jy kan herhaal. Dit maak nie saak in watter volgorde jy hulle herhaal nie. Probeer net om soveel as wat jy kan te herhaal: arm, kat, byl, bed, vliegtuig, oor, hond, hammer, stoel, kar, oog, perd, mes, horlosie, fiets.

Trial 2 through to Trial 5: Ek gaan nou vir jou weer dieselfde lys woorde lees. Wanneer ek klaar is, jy moet soveel van die woorde as wat jy kan herhaal. Sluit in die woorde wat jy alreeds herhaal het. Dit maak nie saak in watter volgorde jy hulle herhaal nie. Probeer net om soveel as wat jy kan te herhaal: arm, kat, byl, bed, vliegtuig, oor, hond, hammer, stoel, kar, oog, perd, mes, horlosie, fiets.

List B: Nou gaan ek vir jou 'n tweede lys woorde lees. Luister goed, want wanneer ek klaar is, jy moet soveel van die woorde as wat jy kan herhaal: skoen, aap, bord, koei, vinger, rok, spinnekop, koppie, gogga, voet, hoed, skoenlapper, ketel, muis, hand.

Immediate Recall: Nou vertel vir my al die woorde wat jy van die eerste lys kan onthou.

Delayed Recall: 'n Rukkie gelede het ek 'n lys woorde vir jou 'n paar keer gelees. Jy moes die woorde herhaal. Vertel vir my al die woorde wat jy van daardie lys kan onthou.

Recognition: Ek gaan nou party woorde vir jou lees. Sommige woorde was op die eerste lys wat ek vir jou gelees het en anders was nie op daardie lys nie. Elke keer as ek 'n word lees, moet jy vir my vertel of die word in die eerste lys was of nie.

Bilingual MAVLT word lists:

Word List A			Word List B		
Item	**English**	**Afrikaans**	**Item**	**English**	**Afrikaans**
1	arm	arm	1	shoe	skoen
2	cat	kat	2	monkey	aap
3	axe	byl	3	plate	bord
4	bed	bed	4	cow	koei
5	plane	vliegtuig	5	finger	vinger
6	ear	oor	6	dress	rok
7	dog	hond	7	spider	spinnekop
8	hammer	hammer	8	cup	koppie
9	chair	stoel	9	bee	gogga
10	car	kar	10	foot	voet
11	eye	oog	11	hat	hoed
12	horse	perd	12	butterfly	skoenlapper
13	knife	mes	13	kettle	ketel
14	clock	horlosie	14	mouse	muis
15	bike	fiets	15	hand	hand

ROCFT: English instructions

Copy: I am going to show you a design. Please copy it here [show location]. Please copy the figure as carefully as you can.

Immediate Recall: You've just copied a design. Now I would like you to draw the design again [show location].

Delayed Recall: Do you remember the design that you drew a while ago? Now I would like you to draw the figure from memory as carefully and completely as you can here [show location].

ROCFT: Afrikaans instructions

Copy: Ek gaan vir jou 'n skets wys. Teken dit asseblief hier [show location]. Teken asseblief die skets so noukeurig as wat jy kan.

Immediate Recall: Jy het netnou 'n skets oorgeteken.
Ek wil hê jy moet weer daardie skets teken [show location].

Delayed Recall: Onthou jy die skets wat jy 'n rukkie gelede oorgeteken het? Ek wil hê jy moet nou daardie skets uit jou kop hier oorteken so noukeurig en volledig moontlik [show location].

SCWT: English instructions

Word Page: This is a test of how fast you can read the words on this page. After I say BEGIN, you are to read down the columns starting with the first one [point to left-most column] until you complete it [run hand down the column] and then continue without stopping down the remaining columns in order [show]. If you finish all the columns before I say STOP, then return to the first column and begin again [point to the first column]. Remember, do not stop reading until I tell you to stop, and read out loud as quickly as you can. If you make a mistake, I will say NO to you. Correct your error and continue without stopping. Are there any questions? Ready? BEGIN.

Color Page: This is a test of how fast you can name the colors on this page. You will complete this page just as you did the previous page, starting with this first column. Remember to name the colors out loud as quickly as you can. Ready? BEGIN.

Color-Word Page: This Word page is like the page you just finished. I want you to name the color of the ink the words are printed in, ignoring the word that is printed for each item. For example [point to the first item of the first column], this is the first item: what would you say? [Correct if necessary, and repeat as many times as necessary until the subject understands]. Good. You will do this page just like the others, starting with the first column [point] and then going on to as many columns as you can. Remember, if you make a mistake, just correct it and go on. Are there any questions? BEGIN.

SCWT: Afrikaans instructions

Word Page: Hierdie is 'n toets van hoe vinnig jy die woorde op hierdie bladsy kan lees. Nadat ek BEGIN gesê het, moet jy die woorde in die kolomme lees. Begin by die eerste een [point to left-most column] totdat jy klaar is [run hand down the column] en gaan dan in volgorde voort sonder om te stop met die oorblywende kolomme [show]. A jy klaar is met al die kolomme voordat ek STOP gesê het, gaan terug na die eerste kolom en begin weer [point to the first column]. Onthou, moenie ophou lees totdat ek STOP sê nie, en lees hardop so gou as jy kan. As jy 'n fout maak, sal ek NEE sê . Maak jou fout reg en gaan voort sonder om te stop. Is daar enige vrae? Gereed? BEGIN.

Color Page: Hierdie is 'n toets van hoe vinnig jy die kleure op hierdie bladsy kan opnoem. Jy moet hierdie bladsy voltooi nes die vorige bladsy. Begin by die eerste kolom. Onthou om die name van die kleure so gou as jy kan hardop te sê. Gereed? BEGIN.

Color-Word Page: Hierdie woordblad is nes die een wat jy nou net voltooi het. Ek wil hê jy moet die kleur van die ink noem waarin die woorde gedruk is. Ignoreer die woord. Byvoorbeeld, [point to the first item of the first column], hierdie is die eerste item: wat gaan jy sê? [Correct if necessary, and repeat as many times as necessary until the subject understands]. Goed. Jy gaan hierdie bladsy doen nes die ander. Begin by die eerste kolom [point] en gaan dan aan na soveel kolomme as wat jy kan. Onthou, as jy 'n fout maak, maak dit reg en gaan voort. Is daar enige vrae? BEGIN.

ToL: English instructions

Demonstration: See these two boards? They are both alike. This board will be the one you'll be using, and this will be the one that I'll be using. I am going to place the beads on the pegs in different patterns. See if you can make these patterns on your board IN AS FEW MOVES AS POSSIBLE, that is, without making extra moves. See if you can make one just like this in as few moves as possible.

Rule Violation 1 Demonstration: Now, there are two rules you have to follow when you are arranging the beads. The first rule is that you are not to place more beads on a peg than it will hold. The second peg can only hold two beads; it cannot hold a third bead [show]. The third peg can only hold one bead; it cannot hold a second bead [show].

Rule Violation 2 Demonstration: The second rule is that you can only move one bead at a time. You cannot move two beads off the pegs at the same time. Notice how I always place the bead on a peg before moving the next one. Now, here are some examples of breaking the rule [demonstrate].

Practice Problem 1: Now make one like this on your board in as few moves as you can.

Problems: Now I am going to set up more bead patterns. See if you can make them on your board in as few moves as possible. You may find that some of the patterns are difficult, but do your best. Each pattern can be solved. NOW MAKE ONE LIKE THIS.

ToL: Afrikaans instructions

Demonstration: Sien jy hierdie twee borde? Hulle lyk eenders. Hierdie bord gaan jy gebruik, en die ander een gaan ek gebruik. Ek gaan die kraletjies in verskillende patrone op die pennetjies sit. Kyk of jy hierdie patrone op jou bord kan herhaal DEUR SO MIN SKUIWE MOONTLIK TE MAAK, met ander woorde, sonder om ekstra skuiwe te maak. Kyk of jy ‘n patroon soos hierdie een kan maak met so min skuiwe moontlik.

Rule Violation 1 Demonstration: Daar is twee reëls wat jy moet volg wanneer jy die kraletjies rangskik. Die eerste reël is dat jy nie meer kraletjies aan ‘n pennetjie mag hang as wat dit kan hou nie. Die tweede pennetjie kan net twee kraletjies hou; daar is nie plek vir ‘n derde nie [show]. Die derde pennetjie kan net een kraletjie hou; daar is nie plek vir ‘n tweede kraletjie nie [show].

Rule Violation 2 Demonstration: Die tweede reël is dat jy net een kraletjie op ‘n slag mag skuif. Jy mag nie twee kraletjies gelyktydig van die pennetjies af skuif nie. Let op dat ek altyd eers ‘n kraletjie terugsit op ‘n pennetjie voordat ek die volgende een skuif. Hier is ‘n paar voorbeelde van hoe die reëls verbreek word.

Practice Problem 1: Maak nou ‘n patroon soos hierdie een op jou bord in so min skuiwe moontlik.

Problems: Ek gaan nou nog patrone met die kraletjies vorm. Kyk of jy dit op jou bord kan herhaal deur so min moontlik skuiwe te maak. Sommige van die patrone sal moeilik wees, maar doen jou bes. Elke patroon kan gevorm word. MAAK EEN SOOS HIERDIE.

Verbal Fluency: English Instructions

Phonemic Fluency: I will say a letter of the alphabet. Then you must name as many words that begin with that letter as quickly as you can. For example, if I say D, you might give me dog, date, dirty. Do not use words which begin with capital letters, like Durban or David. Also, don’t use the same word with different endings, like dig, digger, digging. Do you have any questions? Start when I say the letter.

Semantic Fluency: Now name as many animals as you can. Name them as quickly as possible. Ready, BEGIN.

Verbal Fluency: Afrikaans Instructions

Phonemic Fluency: Ek gaan ‘n letter van die alphabet sê. Dan moet jy so veel moontlik woorde sê wat met daardie letter begin, so gou as wat jy kan. Byvoorbeeld, as ek D sê, mag jy dom, donker, dof sê. Moenie woorde gebruik wat met hoofletters begin nie, soos Durban en Dawid. Moenie dieselfde woord gebruik met verskillende eindes nie, soos deel, deelteken. Het jy enige vrae? Begin as ek die letter noem.

Semantic Fluency: Nou, noem die name van soveel diere as wat jy kan. Noem die diere so vinning as moontlik. Gereed, BEGIN.

WASI Block Design: English Instructions

Now, I am going to ask you to make some designs. You see these blocks? They are all alike. On some sides they are all red; on some all white and on some, half red and half white.

Demonstration (blocks only): I am going to put these blocks together to make a design. Watch me.

Demonstration (blocks and design card): This time we are going to put the blocks together to make them look like this picture. Watch me first. You see, the tops of the blocks look the same as this picture. Now look at the picture and make one just like this with these blocks. Tell me when you are finished. BEGIN.

Before each design: Now make one just like this. Try to work as quickly as you can. Tell me when you have finished.

WASI Block Design: Afrikaans Instructions

Nou gaan ek jou vra om ’n paar ontwerpe te maak. Sien jy hierdie blokkies? Hulle lyk almal eenders. Party blokkies se kante is almal rooi; party se kante is almal witen ander se kante is helfte rooi en helfte wit.

Demonstration (blocks only): Ek gaan hierdie blokkies só pak om ’n ontwerp te maak. Kyk hoe ek dit doen.

Demonstration (blocks and design card): Hierdie keer gaan ons die blokkies só pak dat dit net soos hierdie prentjie lyk. Kyk eers hoe ek dit doen. Jy sien, die blokkies se boonste kante lyk net soos hierdie prentjie. Kyk nou na die prentjie en maak et so ’n prentjie met hierdie blokkies. Sê vir my wanneer jy klaar is. BEGIN.

Before each design: Maak nou ‘n ontwerp wat soos hierdie een lyk. Probeer so vinnig moontlik te werk.Sê vir my wanneer jy klaar is.

WASI Matrix Reasoning: English Instructions

Now I am going to show you some pictures. In each picture, there is a piece missing. Look carefully at all the pieces of each picture and choose the missing piece from the five choices at the bottom of the page. There is only one correct answer to each problem. If you believe that more than one answer is right, choose the best one.

WASI Matrix Reasoning: Afrikaans Instructions

Ek gaan vir jou ‘n paar prente wys. In elke prent is daar ‘n stuk weg. Kyk baie goed na al die stukke van elke prent, en kies dan die stuk wat weg is uit die vyf keuses onder aan die bladsy.

Daar is net een regte antwoord op elke probleem. As jy glo dat meer as een antwoord reg is, kies die beste een.

WASI Vocabulary: English Instructions

Now, I am going to ask you to tell me the meanings of some words.

Listen carefully and tell me what each word means. Are you ready?

WASI Vocabulary: Afrikaans Instructions

Nou gaan ek jou vra om die betekenisse van party woorde vir my te vertel.

Luister goed en vertel vir my wat elke word beteken. Is jy gereed?

WASI Vocabulary: Bilingual word list:

Item	English	Afrikaans
5	shirt	hemp
6	shoe	skoen
7	torch	flits
8	car	kar
9	bird	voël
10	calendar	kalender
11	number	nommer
12	bell	klokkie
13	breakfast	ontbyt
14	police	polisie
15	vacation	vakansie
16	repair	herstel
17	balloon	ballon
18	transform	omskep
19	crocodile	alligator
20	cart	waentjie
21	blame	blaam
22	dance	dans
23	purpose	doelwit
24	entertain	vermaak
25	famous	beroemd

26	reveal	onthul
27	century	eeu
28	tradition	tradisie
29	rejoice	jubel
30	enthusiastic	entoesiasties
31	complicated	gekompliseerd
32	impulse	impuls
33	haste	haastigheid
34	trend	tendens
35	intermittent	onderbroke
36	compassion	deernis
37	impertinent	parmantig
38	colony	kolonie
39	presumptuous	voorbarig
40	formidable	formidabel
41	ruminate	peins
42	tirade	tirade

WASI Similarities: English Instructions

In the following section, I am going to read two words to you.

I would like you to tell me how they are the same. For example, if I ask "How are biscuits and sweets the same", you would say "They are both snacks or food".

WASI Similarities: Afrikaans instructions

In die volgende afdeling, ek gaan twee woorde vir jou lees. Ek wil hê jy moet vir my vertel hoe hulle dieselfde is. Byvoorbeeld, as ek vra "Hoe is koekies en lekkers dieselfde", jy sal sê, "hulle is albei peuselhappies of kos".

WASI Similarities: Bilingual word list:

Item	**English**	**Afrikaans**
5	red-blue	rooi-blou
6	circle-square	sirkel-vierkant
7	grapes-strawberries	druiwe-aarbeie
8	cow-bear	koei-beer
9	plane-bus	vliegtuig-bus
10	shirt-jacket	hemp-baaidjie
11	pen-pencil	pen-potlood
12	plate-bowl	bord-bakkie
13	love-hate	liefde-haat
14	TV-newspaper	TV-koerant
15	smooth-rough	glad-grof
16	shoulder-ankle / skouer-enkel	skouer-enkel
17	sit-run	sit-hardloop
18	child-adult	kind-volwassene
19	steam-cloud	stoom-wolk
20	bird-flower	voël-blom
21	less-more	minder-meer
22	photograph-song	foto-lied
23	peace-war	vrede-oorlog
24	Capitalism-Socialism	Kapitalisme-Sosialisme
25	tradition-habit	tradisie-gewoonte
26	freedom-law	vryheid-wet

WISC-IV Coding: English instructions

Demonstration items (Sample Items 1-3): [Point to the key at the top of the page and say] look at these boxes. Each box has a number in the top part [sweep your finger along the numbers from 1 to 9] and a special mark in the bottom part [sweep your finger along the symbols]. Each number has its own mark [point to 1 and its symbol, then to 2 and its symbol. Point to the sample items and say] down here the boxes have numbers in the top parts but are empty in the bottom parts. You are to draw the marks that belong in the empty boxes, like this. [Point to the first sample item (2) and then to the key to show its corresponding symbol. Say] here is a 2. The 2 has this mark. So I draw that mark in the empty box, like this [demonstrate by writing the symbol. Point to the second sample item (1) and then to the key and say] here is a 1. The 1 has this mark. So I draw that mark in the box [demonstrate by writing the symbol. Point to the third sample item (4) and then to the key and say] this is a 4. The 4 has this mark. So I draw that mark in the box [demonstrate by writing the symbol].

Practice items: (Sample Items 4-7): [Hand the subject a pencil without an eraser and say] now you do these. [Point to the remaining sample items and say] stop when you get to this line [point. Allow the subject to work alone on the remaining sample items. Correct errors immediately. Only proceed when the subject has completed the sample items correctly. Say] now you know how to do them.

Test items: When I say BEGIN, do these the same way. Start here [point to the first test item], go in order, and don’t skip any. Work as fast as you can without making mistakes until I tell you to stop. Are you ready? BEGIN.

WISC-IV Coding: Afrikaans instructions

Demonstration items (Sample Items 1-3): [Point to the key at the top of the page (in Response Booklet) and say] kyk goed na hierdie blok. By elkeen is daar ’n getal aan die bokant [sweep your finger along the numbers from 1 to 9] en ’n spesiale teken onder [sweep your finger along the symbols]. Elke getal het sy eie teken [point to 1 and its symbol, then to 2 and its symbol. Point to the sample items and say] hierdie blokke het getalle bo, maar is leeg onder. Jy moet die tekens wat in die leë ruimtes moet kom, daarin oorteken. Só doen jy dit [point to the first sample item (2) and then to the key to show its corresponding symbol. Say] hier is ’n 2. Die syfer 2 het hierdie teken. Nou maak ek hierdie teken só in die leë ruimte [demonstrate by writing the symbol. Point to the second sample item (1) and then to the key and say] hier is ’n 1. Die syfer 1 het hierdie teken. Nou maak ek hierdie teken in die leë ruimte [demonstrate. Point to the third sample item (4) and then to the key and say] dit is ’n 4. Die syfer 4 het hierdie teken. Nou maak ek hierdie teken in die leë ruimte [demonstrate].

Practice items: (Sample Items 4-7): [Hand the subject a pencil without an eraser and say] doen jy nou hierdie paar. [Point to the remaining sample items and say] hou op wanneer jy by hierdie streep kom [point. Allow the subject to work alone on the remaining sample items. Correct errors immediately. Only proceed when the subject has completed the sample items correctly. Say] nou weet jy hoe om dit te doen.

Test items: Wanneer ek sê BEGIN, doen hierdie paar op dieselfde manier. Begin hier [point to the first test item], doen almal in volgorde, en moenie een oorslaan nie. Werk so vinnig as wat jy kan sonder om foute te maak, totdat ek vir jou sê jy moet ophou. Is jy gereed? BEGIN.

Appendix D

Normative Conversion Tables

Table 1. *CCTT Trial 1 Normative Conversion Table: for 12-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-145	>99	77- ≥80	18 - ≥19	> 2.67	<16
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	16
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	17
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	18
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	19
	80			0.84	20
112	79	58		0.81	
	78			0.77	21
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	22
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	23
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	24
	51			0.03	
100	50	50	10	0	25

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	25
98	45			-0.13	
	44			-0.15	26
	43			-0.18	
97	42	48		-0.20	27
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	28
94	34	46		-0.41	29
	33			-0.44	30
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	31
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	32
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	33
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	34
	11			-1.23	
81	10	37		-1.28	35
80	9		6	-1.34	36
79	8	36		-1.41	
78	7	35		-1.48	37
77	6			-1.56	
75-76	5	34	5	-1.65	38
73-74	4	32-33		-1.75	39
71-72	3	31		-1.88	40
68-70	2	28-30	4	-2.05	41
61-67	1	24-27	3	-2.33	42
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>43

Note. Raw score completion times are presented in seconds; Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 31) included female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 7 years of education.

Table 2. *CCTT Trial 1 Normative Conversion Table: for 12-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	≤16
133-139	99	73-76	17	2.33	17
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	18
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	19
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	20
117	87			1.13	
116	86	61		1.08	
	85			1.04	21
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	22
113	81			0.88	23
	80			0.84	24
112	79	58		0.81	25
	78			0.77	26
111	77			0.74	
	76	57		0.71	27
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	28
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	29
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	30
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	31
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	32
98	45			-0.13	
	44			-0.15	33
	43			-0.18	34
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	35
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	36
92	30			-0.52	
	29			-0.55	
	28			-0.58	37
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	38
	24	43		-0.71	
89	23			-0.74	39
	22			-0.77	40
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	41
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	42
	15			-1.04	
84	14	39		-1.08	43
83	13			-1.13	44
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	45
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	46
73-74	4	32-33		-1.75	47
71-72	3	31		-1.88	48
68-70	2	28-30	4	-2.05	49
61-67	1	24-27	3	-2.33	50
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	≥51

Note. Raw score completion times are presented in seconds; Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 34) included female and male, Afrikaans- and English-speaking, coloured participants with 5 to 7 years of education.

Table 3. *CCTT Trial 1 Normative Conversion Table: for 13- to 15-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	<9
133-139	99	73-76	17	2.33	9
130-132	98	70-72	16	2.05	10
128-129	97	69		1.88	11
126-127	96	67-68		1.75	12
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	13
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	14
	83			0.95	
114	82	59		0.92	
113	81			0.88	15
	80			0.84	
112	79	58		0.81	16
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	17
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	18
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	19
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	20
102	55			0.13	
	54	51		0.10	
101	53			0.08	21
	52			0.05	
	51			0.03	22
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	23
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	24
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	25
93	32			-0.47	26
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	27
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	28
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	29
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	30
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	31
77	6			-1.56	32
75-76	5	34	5	-1.65	33
73-74	4	32-33		-1.75	34
71-72	3	31		-1.88	35
68-70	2	28-30	4	-2.05	36
61-67	1	24-27	3	-2.33	40
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>40

Note. Raw score completion times are presented in seconds; Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 63) included female and male, Afrikaans- and English-speaking, coloured and white participants with 6 to 10 years of education.

Table 4. *CCTT Trial 1 Normative Conversion Table: for 13- to 15-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw	Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	<10	100	50	50	10	0	
							49			-0.03	
133-139	99	73-76	17	2.33	10		48			-0.05	
130-132	98	70-72	16	2.05	11	99	47			-0.08	
128-129	97	69		1.88			46	49		-0.10	
126-127	96	67-68		1.75	12	98	45			-0.13	
124-125	95	66	15	1.65			44			-0.15	
123	94			1.56	13		43			-0.18	24
122	93	65		1.48		97	42	48		-0.20	
121	92	64		1.41			41			-0.23	
120	91		14	1.34	14		40			-0.25	
119	90	63		1.28		96	39			-0.28	
	89			1.23			38	47		-0.31	25
118	88	62		1.18		95	37		9	-0.33	
117	87			1.13	15		36			-0.36	26
116	86	61		1.08			35			-0.39	
	85			1.04		94	34	46		-0.41	27
115	84	60	13	0.99	16		33			-0.44	
	83			0.95		93	32			-0.47	
114	82	59		0.92			31	45		-0.50	
113	81			0.88	17	92	30			-0.52	
	80			0.84			29			-0.55	28
112	79	58		0.81			28			-0.58	
	78			0.77	18	91	27	44		-0.61	
111	77			0.74			26			-0.64	
	76	57		0.71		90	25		8	-0.67	29
110	75		12	0.67			24	43		-0.71	
	74			0.64	19	89	23			-0.74	
109	73	56		0.61			22			-0.77	
	72			0.58		88	21	42		-0.81	
	71			0.55	20		20			-0.84	30
108	70			0.52		87	19			-0.88	
	69	55		0.50		86	18	41		-0.92	
107	68			0.47			17			-0.95	31
	67			0.44		85	16	40	7	-0.99	
106	66	54		0.41			15			-1.04	32
	65			0.39		84	14	39		-1.08	
	64			0.36	21	83	13			-1.13	33
105	63		11	0.33		82	12	38		-1.18	34
	62	53		0.31			11			-1.23	35
104	61			0.28		81	10	37		-1.28	36
	60			0.25		80	9		6	-1.34	
	59			0.23		79	8	36		-1.41	37
103	58	52		0.20		78	7	35		-1.48	38
	57			0.18		77	6			-1.56	39
	56			0.15	22	75-76	5	34	5	-1.65	40
102	55			0.13		73-74	4	32-33		-1.75	41
	54	51		0.10		71-72	3	31		-1.88	45
101	53			0.08		68-70	2	28-30	4	-2.05	50
	52			0.05	23	61-67	1	24-27	3	-2.33	52
	51			0.03		≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>52
100	50	50	10	0							

Note. Raw score completion times are presented in seconds; Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 87) included female and male, Afrikaans- and English-speaking, coloured participants with 6 to 10 years of education.

Table 5. *CCTT Trial 2 Normative Conversion Table: for 12-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 -≥19	> 2.67	<27
133-139	99	73-76	17	2.33	27
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	28
126-127	96	67-68		1.75	29
124-125	95	66	15	1.65	30
123	94			1.56	31
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	32
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	33
111	77			0.74	
	76	57		0.71	34
110	75		12	0.67	35
	74			0.64	36
109	73	56		0.61	37
	72			0.58	
	71			0.55	38
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	39
	64			0.36	40
105	63		11	0.33	41
	62	53		0.31	42
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	43
100	50	50	10	0	44

Std	%ile	T	SS	z	Raw
100	50	50	10	0	44
	49			-0.03	45
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	46
	41			-0.23	
	40			-0.25	
96	39			-0.28	47
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	48
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	49
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	50
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	51
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	52
82	12	38		-1.18	53
	11			-1.23	
81	10	37		-1.28	54
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	55
77	6			-1.56	56
75-76	5	34	5	-1.65	57
73-74	4	32-33		-1.75	58
71-72	3	31		-1.88	59
68-70	2	28-30	4	-2.05	61
61-67	1	24-27	3	-2.33	63
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>63

Note. Raw score completion times are presented in seconds; Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 31) included female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 7 years of education.

Table 6. *CCTT Trial 2 Normative Conversion Table: for 12-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	<33
133-139	99	73-76	17	2.33	33
130-132	98	70-72	16	2.05	35
128-129	97	69		1.88	36
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	37
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	38
119	90	63		1.28	39
	89			1.23	
118	88	62		1.18	40
117	87			1.13	41
116	86	61		1.08	
	85			1.04	42
115	84	60	13	0.99	43
	83			0.95	44
114	82	59		0.92	45
113	81			0.88	
	80			0.84	
112	79	58		0.81	46
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	47
	69	55		0.50	
107	68			0.47	
	67			0.44	48
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	49
	62	53		0.31	
104	61			0.28	50
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	51
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	52
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	53
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	54
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	55
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	56
	31	45		-0.50	57
92	30			-0.52	
	29			-0.55	58
	28			-0.58	59
91	27	44		-0.61	
	26			-0.64	60
90	25		8	-0.67	61
	24	43		-0.71	62
89	23			-0.74	63
	22			-0.77	64
88	21	42		-0.81	
	20			-0.84	65
87	19			-0.88	66
86	18	41		-0.92	
	17			-0.95	67
85	16	40	7	-0.99	68
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	69
82	12	38		-1.18	70
	11			-1.23	71
81	10	37		-1.28	73
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	75
75-76	5	34	5	-1.65	81
73-74	4	32- 33		-1.75	87
71-72	3	31		-1.88	93
68-70	2	28- 30	4	-2.05	95
61-67	1	24- 27	3	-2.33	97
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>97

Note. Raw score completion times are presented in seconds; Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 34) included female and male, Afrikaans- and English-speaking, coloured participants with 5 to 7 years of education.

Table 7. *CCTT Trial 2 Normative Conversion Table: for 13- to 15-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	<20
133-139	99	73-76	17	2.33	20
130-132	98	70-72	16	2.05	21
128-129	97	69		1.88	23
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	24
120	91		14	1.34	25
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	26
116	86	61		1.08	27
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	28
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	29
109	73	56		0.61	30
	72			0.58	
	71			0.55	31
108	70			0.52	
	69	55		0.50	32
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	33
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	34
	57			0.18	
	56			0.15	35
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	36
	48			-0.05	37
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	38
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	39
	35			-0.39	40
94	34	46		-0.41	
	33			-0.44	41
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	42
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	43
87	19			-0.88	44
86	18	41		-0.92	
	17			-0.95	45
85	16	40	7	-0.99	
	15			-1.04	46
84	14	39		-1.08	47
83	13			-1.13	
82	12	38		-1.18	48
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	49
79	8	36		-1.41	50
78	7	35		-1.48	51
77	6			-1.56	52
75-76	5	34	5	-1.65	53
73-74	4	32-33		-1.75	54
71-72	3	31		-1.88	57
68-70	2	28-30	4	-2.05	68
61-67	1	24-27	3	-2.33	73
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>73

Note. Raw score completion times are presented in seconds; Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 63) included female and male, Afrikaans- and English-speaking, coloured and white participants with 6 to 10 years of education.

Table 8. *CCTT Trial 2 Normative Conversion Table: for 13- to 15-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw	Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	<21	100	50	50	10	0	43
133-139	99	73-76	17	2.33	21		49			-0.03	44
130-132	98	70-72	16	2.05	23		48			-0.05	45
128-129	97	69		1.88	24	99	47			-0.08	
126-127	96	67-68		1.75	25		46	49		-0.10	
124-125	95	66	15	1.65	27	98	45			-0.13	46
123	94			1.56	28		44			-0.15	
122	93	65		1.48			43			-0.18	47
121	92	64		1.41	29	97	42	48		-0.20	
120	91		14	1.34	30		41			-0.23	
119	90	63		1.28			40			-0.25	48
	89			1.23	31	96	39			-0.28	
118	88	62		1.18			38	47		-0.31	
117	87			1.13	32	95	37		9	-0.33	
116	86	61		1.08	33		36			-0.36	49
	85			1.04			35			-0.39	
115	84	60	13	0.99	34	94	34	46		-0.41	
	83			0.95			33			-0.44	50
114	82	59		0.92		93	32			-0.47	
113	81			0.88			31	45		-0.50	
	80			0.84		92	30			-0.52	51
112	79	58		0.81	35		29			-0.55	
	78			0.77	36		28			-0.58	52
111	77			0.74		91	27	44		-0.61	
	76	57		0.71			26			-0.64	53
110	75		12	0.67		90	25		8	-0.67	54
	74			0.64	37		24	43		-0.71	
109	73	56		0.61		89	23			-0.74	
	72			0.58			22			-0.77	55
	71			0.55	38	88	21	42		-0.81	56
108	70			0.52			20			-0.84	57
	69	55		0.50		87	19			-0.88	58
107	68			0.47		86	18	41		-0.92	
	67			0.44			17			-0.95	
106	66	54		0.41	39	85	16	40	7	-0.99	
	65			0.39			15			-1.04	59
	64			0.36		84	14	39		-1.08	
105	63		11	0.33	40	83	13			-1.13	
	62	53		0.31		82	12	38		-1.18	60
104	61			0.28			11			-1.23	61
	60			0.25		81	10	37		-1.28	62
	59			0.23		80	9		6	-1.34	63
103	58	52		0.20		79	8	36		-1.41	
	57			0.18	41	78	7	35		-1.48	
	56			0.15		77	6			-1.56	64
102	55			0.13	42	75-76	5	34	5	-1.65	67
	54	51		0.10		73-74	4	32-33		-1.75	72
101	53			0.08		71-72	3	31		-1.88	77
	52			0.05		68-70	2	28-30	4	-2.05	83
	51			0.03		61-67	1	24-27	3	-2.33	90
100	50	50	10	0	43	≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>90

Note. Raw score completion times are presented in seconds; Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 87) included female and male, Afrikaans- and English-speaking, coloured participants with 6 to 10 years of education.

Table 9. *CMS Numbers Forward Normative Conversion Table: for Afrikaans-speaking, coloured participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 -≥19	> 2.67	10-16
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	9
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	8
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	7
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	6
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	5
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	4
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	3
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	2
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	1
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 6) included 12- to 15-year old, female and male participants with 5 to 10 years of education.

Table 10. *CMS Numbers Forward Normative Conversion Table: for Afrikaans-speaking, white participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	12-16
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	11
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	10
100	50	50	10	0	10
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	9
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	8
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-7

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 10) included 12- to 15-year old, female and male participants with 5 to 10 years of education.

Table 11. *CMS Numbers Forward Normative Conversion Table: for Afrikaans-speaking, coloured participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	11-16
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	10
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	9
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	8
	51			0.03	
100	50	50	10	0	7
100	50	50	10	0	7
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	7
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	6
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	5
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-4

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 77) included 12- to 15-year old, female and male participants with 5 to 10 years of education.

Table 12. *CMS Numbers Forward Normative Conversion Table: for English-speaking, coloured participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	14-16
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	13
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	12
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63			0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	11
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	10
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	9
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	8
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	7
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	6
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-5

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 21) included 12- to 15-year old, female and male participants with 5 to 10 years of education.

Table 13. *CMS Numbers Forward Normative Conversion Table: for English-speaking, white participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw	Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	15-16	100	50	50	10	0	
133-139	99	73-76	17	2.33			49			-0.03	
130-132	98	70-72	16	2.05			48			-0.05	
128-129	97	69		1.88		99	47			-0.08	
126-127	96	67-68		1.75			46	49		-0.10	
124-125	95	66	15	1.65		98	45			-0.13	
123	94			1.56			44			-0.15	
122	93	65		1.48			43			-0.18	
121	92	64		1.41	14	97	42	48		-0.20	
120	91		14	1.34			41			-0.23	
119	90	63		1.28			40			-0.25	
	89			1.23		96	39			-0.28	
118	88	62		1.18			38	47		-0.31	
117	87			1.13		95	37		9	-0.33	
116	86	61		1.08			36			-0.36	
	85			1.04			35			-0.39	10
115	84	60	13	0.99		94	34	46		-0.41	
	83			0.95			33			-0.44	
114	82	59		0.92		93	32			-0.47	
113	81			0.88			31	45		-0.50	
	80			0.84	13	92	30			-0.52	
112	79	58		0.81			29			-0.55	
	78			0.77			28			-0.58	
111	77			0.74		91	27	44		-0.61	
	76	57		0.71			26			-0.64	
110	75		12	0.67		90	25		8	-0.67	9
	74			0.64			24	43		-0.71	
109	73	56		0.61		89	23			-0.74	
	72			0.58			22			-0.77	
	71			0.55	12	88	21	42		-0.81	
108	70			0.52			20			-0.84	
	69	55		0.50		87	19			-0.88	
107	68			0.47		86	18	41		-0.92	
	67			0.44			17			-0.95	
106	66	54		0.41		85	16	40	7	-0.99	
	65			0.39			15			-1.04	
	64			0.36		84	14	39		-1.08	
105	63		11	0.33		83	13			-1.13	
	62	53		0.31		82	12	38		-1.18	
104	61			0.28			11			-1.23	
	60			0.25		81	10	37		-1.28	
	59			0.23		80	9		6	-1.34	8
103	58	52		0.20		79	8	36		-1.41	
	57			0.18		78	7	35		-1.48	
	56			0.15		77	6			-1.56	
102	55			0.13		75-76	5	34	5	-1.65	
	54	51		0.10		73-74	4	32-33		-1.75	
101	53			0.08	11	71-72	3	31		-1.88	
	52			0.05		68-70	2	28-30	4	-2.05	
	51			0.03		61-67	1	24-27	3	-2.33	7
100	50	50	10	0		≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-6

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 57) included 12- to 15-year old, female and male participants with 5 to 10 years of education.

Table 14. *CMS Numbers Forward Normative Conversion Table: for English-speaking, coloured participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	13-16
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	12
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	11
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	10
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	9
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	8

Std	%ile	T	SS	z	Raw
100	50	50	10	0	8
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	8
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	7
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	6
61-67	1	24-27	3	-2.33	5
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-4

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 44) included 12- to 15-year old, female and male participants with 5 to 10 years of education.

Table 15. *CMS Numbers Backward Normative Conversion Table: for 12- to 14-year-old, Afrikaans-speaking participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	9-14
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	8
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	7
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	6
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	5
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	4
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	3
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	2
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-1

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 12) included female and male, coloured and white participants with 5 to 9 years of education.

Table 16. *CMS Numbers Backward Normative Conversion Table: for 12- to 14-year-old, Afrikaans-speaking participants with disadvantaged quality of education*

Std	**%ile**	**T**	**SS**	**z**	**Raw**
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	9-14
133-139	99	73-76	17	2.33	8
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	6
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	5
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	**%ile**	**T**	**SS**	**z**	**Raw**
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	4
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	3
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	2
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-1

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 50) included female and male, coloured participants with 5 to 9 years of education.

Table 17. *CMS Numbers Backward Normative Conversion Table: for 12- to 14-year-old, English-speaking, participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw	Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	12-14	100	50	50	10	0	6
133-139	99	73-76	17	2.33			49			-0.03	
							48			-0.05	
130-132	98	70-72	16	2.05	11	99	47			-0.08	
128-129	97	69		1.88			46	49		-0.10	
126-127	96	67-68		1.75	10	98	45			-0.13	
124-125	95	66	15	1.65			44			-0.15	
123	94			1.56			43			-0.18	
122	93	65		1.48	9	97	42	48		-0.20	
121	92	64		1.41			41			-0.23	
120	91		14	1.34			40			-0.25	
119	90	63		1.28		96	39			-0.28	
	89			1.23			38	47		-0.31	
118	88	62		1.18		95	37		9	-0.33	
117	87			1.13			36			-0.36	
116	86	61		1.08			35			-0.39	
	85			1.04		94	34	46		-0.41	
115	84	60	13	0.99	8		33			-0.44	
	83			0.95		93	32			-0.47	
114	82	59		0.92			31	45		-0.50	
113	81			0.88		92	30			-0.52	5
	80			0.84			29			-0.55	
112	79	58		0.81			28			-0.58	
	78			0.77		91	27	44		-0.61	
111	77			0.74			26			-0.64	
	76	57		0.71		90	25		8	-0.67	
110	75		12	0.67			24	43		-0.71	
	74			0.64		89	23			-0.74	
109	73	56		0.61			22			-0.77	
	72			0.58	7	88	21	42		-0.81	
	71			0.55			20			-0.84	
108	70			0.52		87	19			-0.88	
	69	55		0.50		86	18	41		-0.92	
107	68			0.47			17			-0.95	
	67			0.44		85	16	40	7	-0.99	
106	66	54		0.41			15			-1.04	
	65			0.39		84	14	39		-1.08	
	64			0.36		83	13			-1.13	
105	63		11	0.33		82	12	38		-1.18	
	62	53		0.31			11			-1.23	
104	61			0.28		81	10	37		-1.28	
	60			0.25		80	9		6	-1.34	4
	59			0.23		79	8	36		-1.41	
103	58	52		0.20		78	7	35		-1.48	
	57			0.18		77	6			-1.56	
	56			0.15		75-76	5	34	5	-1.65	3
102	55			0.13		73-74	4	32-33		-1.75	
	54	51		0.10		71-72	3	31		-1.88	
101	53			0.08		68-70	2	28-30	4	-2.05	
	52			0.05		61-67	1	24-27	3	-2.33	2
	51			0.03		≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-1
100	50	50	10	0	6						

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 63) included female and male, coloured and white participants with 5 to 9 years of education.

Table 18. *CMS Numbers Backward Normative Conversion Table: for 12- to 14-year-old, English-speaking participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	8-14
133-139	99	73-76	17	2.33	7
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	6
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	5
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	4
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	3
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	2
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-1

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 34) included female and male, coloured participants with 5 to 9 years of education.

Table 19. *CMS Numbers Backward Normative Conversion Table: for 15-year-old, Afrikaans-speaking participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77- ≥80	18 - ≥19	> 2.67	9-14
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	8
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	7

Std	%ile	T	SS	z	Raw
100	50	50	10	0	7
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	6
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-5

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 4) included female and male, coloured and white participants with 8 to 10 years of education.

Table 20. *CMS Numbers Backward Normative Conversion Table: for 15-year-old, Afrikaans-speaking participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	8-14
133-139	99	73-76	17	2.33	7
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	6
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	5
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	4
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	3
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	2
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-1

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 27) included female and male, coloured participants with 8 to 10 years of education.

Table 21. *CMS Numbers Backward Normative Conversion Table: for 15-year-old, English-speaking participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw	Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 -≥19	> 2.67	13-14	100	50	50	10	0	
133-139	99	73-76	17	2.33	12		49			-0.03	
130-132	98	70-72	16	2.05			48			-0.05	
128-129	97	69		1.88		99	47			-0.08	7
126-127	96	67-68		1.75			46	49		-0.10	
124-125	95	66	15	1.65	11	98	45			-0.13	
123	94			1.56			44			-0.15	
122	93	65		1.48			43			-0.18	
121	92	64		1.41		97	42	48		-0.20	
120	91		14	1.34			41			-0.23	
119	90	63		1.28	10		40			-0.25	
	89			1.23		96	39			-0.28	
118	88	62		1.18			38	47		-0.31	
117	87			1.13		95	37		9	-0.33	
116	86	61		1.08			36			-0.36	
	85			1.04			35			-0.39	
115	84	60	13	0.99		94	34	46		-0.41	
	83			0.95	9		33			-0.44	6
114	82	59		0.92		93	32			-0.47	
113	81			0.88			31	45		-0.50	
	80			0.84		92	30			-0.52	
112	79	58		0.81			29			-0.55	
	78			0.77			28			-0.58	
111	77			0.74		91	27	44		-0.61	
	76	57		0.71			26			-0.64	
110	75		12	0.67		90	25		8	-0.67	
	74			0.64			24	43		-0.71	
109	73	56		0.61		89	23			-0.74	
	72			0.58			22			-0.77	
	71			0.55		88	21	42		-0.81	
108	70			0.52			20			-0.84	
	69	55		0.50		87	19			-0.88	
107	68			0.47		86	18	41		-0.92	
	67			0.44			17			-0.95	
106	66	54		0.41		85	16	40	7	-0.99	
	65			0.39			15			-1.04	
	64			0.36		84	14	39		-1.08	
105	63		11	0.33		83	13			-1.13	
	62	53		0.31		82	12	38		-1.18	
104	61			0.28			11			-1.23	5
	60			0.25		81	10	37		-1.28	
	59			0.23		80	9		6	-1.34	
103	58	52		0.20		79	8	36		-1.41	
	57			0.18		78	7	35		-1.48	
	56			0.15		77	6			-1.56	
102	55			0.13		75-76	5	34	5	-1.65	
	54	51		0.10	8	73-74	4	32-33		-1.75	
101	53			0.08		71-72	3	31		-1.88	
	52			0.05		68-70	2	28-30	4	-2.05	
	51			0.03		61-67	1	24-27	3	-2.33	4
100	50	50	10	0		≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-3

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 15) included female and male, coloured and white participants with 8 to 10 years of education.

Table 22. *CMS Numbers Backward Normative Conversion Table: for 15-year-old, English-speaking participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77- ≥80	18 - ≥19	> 2.67	9-14
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	8
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	7
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	6
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	5
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	4
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	3
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-2

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 27) included female and male, coloured participants with 8 to 10 years of education.

Table 23. *CLOX Test Trial 1 Normative Conversion Table: for participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	15
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	14
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	13

Std	%ile	T	SS	z	Raw
100	50	50	10	0	13
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	13
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	12
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	11
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	10
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-9

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 94) included 12- to 15-year-old, female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 10 years of education.

Table 24. *CLOX Test Trial 1 Normative Conversion Table: for participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	
133-139	99	73-76	17	2.33	15
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	14
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	13

Std	%ile	T	SS	z	Raw
100	50	50	10	0	13
	49			-0.03	13
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	12
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	11
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	10
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	9
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	8
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-7

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 121) included 12- to 15-year-old, female and male, Afrikaans- and English-speaking, coloured participants with 5 to 10 years of education.

Table 25. *CLOX Test Trial 2 Normative Conversion Table: for female participants*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	15
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	14

Std	%ile	T	SS	z	Raw
100	50	50	10	0	14
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	14
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	13
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	12
61-67	1	24-27	3	-2.33	11
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-10

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 117) included 12- to 15-year-old, Afrikaans- and English-speaking, coloured and white participants with 5 to 10 years of advantaged and disadvantaged quality of education.

Table 26. *CLOX Test Trial 2 Normative Conversion Table: for male participants*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	15
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	14

Std	%ile	T	SS	z	Raw
100	50	50	10	0	14
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	14
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	13
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	12
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	11
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-10

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 98) included 12- to 15-year-old, Afrikaans- and English-speaking, coloured and white participants with 5 to 10 years of advantaged and disadvantaged quality of education.

Table 27. *GPT 1 Dominant Hand Peg Insertion Normative Conversion Table: for 12- to 13-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw	Std	%ile	T	SS	z	Raw
140-≥145	>99	77- ≥80	18 - ≥19	> 2.67	<58	100	50	50	10	0	70
133-139	99	73-76	17	2.33			49			-0.03	
130-132	98	70-72	16	2.05	58		48			-0.05	
128-129	97	69		1.88		99	47			-0.08	
126-127	96	67-68		1.75			46	49		-0.10	70
124-125	95	66	15	1.65		98	45			-0.13	
123	94			1.56			44			-0.15	
122	93	65		1.48	59		43			-0.18	
121	92	64		1.41	60	97	42	48		-0.20	
120	91		14	1.34	61		41			-0.23	
119	90	63		1.28			40			-0.25	
	89			1.23		96	39			-0.28	
118	88	62		1.18	62		38	47		-0.31	
117	87			1.13		95	37		9	-0.33	71
116	86	61		1.08			36			-0.36	
	85			1.04			35			-0.39	
115	84	60	13	0.99	63	94	34	46		-0.41	
	83			0.95			33			-0.44	
114	82	59		0.92		93	32			-0.47	72
113	81			0.88			31	45		-0.50	
	80			0.84	64	92	30			-0.52	
112	79	58		0.81			29			-0.55	
	78			0.77			28			-0.58	73
111	77			0.74		91	27	44		-0.61	
	76	57		0.71			26			-0.64	
110	75		12	0.67	65	90	25		8	-0.67	74
	74			0.64			24	43		-0.71	
109	73	56		0.61		89	23			-0.74	
	72			0.58			22			-0.77	
	71			0.55	66	88	21	42		-0.81	
108	70			0.52			20			-0.84	75
	69	55		0.50		87	19			-0.88	76
107	68			0.47		86	18	41		-0.92	77
	67			0.44			17			-0.95	78
106	66	54		0.41		85	16	40	7	-0.99	79
	65			0.39			15			-1.04	
	64			0.36		84	14	39		-1.08	80
105	63		11	0.33		83	13			-1.13	81
	62	53		0.31	67	82	12	38		-1.18	83
104	61			0.28			11			-1.23	
	60			0.25	68	81	10	37		-1.28	
	59			0.23		80	9		6	-1.34	
103	58	52		0.20		79	8	36		-1.41	
	57			0.18		78	7	35		-1.48	
	56			0.15		77	6			-1.56	
102	55			0.13	69	75-76	5	34	5	-1.65	84
	54	51		0.10		73-74	4	32-33		-1.75	86
101	53			0.08		71-72	3	31		-1.88	87
	52			0.05		68-70	2	28-30	4	-2.05	89
	51			0.03		61-67	1	24-27	3	-2.33	92
100	50	50	10	0	70	≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>92

Note. Raw score completion times are presented in seconds; Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 54) included right-handed, female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 8 years of education.

Table 28. *GPT 1 Dominant Hand Peg Insertion Normative Conversion Table: for 12- to 13-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	<54
133-139	99	73-76	17	2.33	54
130-132	98	70-72	16	2.05	57
128-129	97	69		1.88	
126-127	96	67-68		1.75	58
124-125	95	66	15	1.65	
123	94			1.56	59
122	93	65		1.48	
121	92	64		1.41	60
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	61
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	62
	83			0.95	63
114	82	59		0.92	64
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	65
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	66
	72			0.58	67
	71			0.55	
108	70			0.52	68
	69	55		0.50	
107	68			0.47	69
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	70
104	61			0.28	
	60			0.25	
	59			0.23	71
103	58	52		0.20	72
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	73
	52			0.05	
	51			0.03	74
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	74
	49			-0.03	74
	48			-0.05	
99	47			-0.08	75
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	76
97	42	48		-0.20	77
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	78
	36			-0.36	79
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	80
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	81
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	82
	22			-0.77	
88	21	42		-0.81	83
	20			-0.84	84
87	19			-0.88	85
86	18	41		-0.92	
	17			-0.95	86
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	87
82	12	38		-1.18	88
	11			-1.23	90
81	10	37		-1.28	92
80	9		6	-1.34	93
79	8	36		-1.41	95
78	7	35		-1.48	
77	6			-1.56	96
75-76	5	34	5	-1.65	97
73-74	4	32-33		-1.75	98
71-72	3	31		-1.88	104
68-70	2	28-30	4	-2.05	110
61-67	1	24-27	3	-2.33	115
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>115

Note. Raw score completion times are presented in seconds; Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 47) included right-handed, female and male, Afrikaans- and English-speaking, coloured participants with 5 to 8 years of education.

Table 29. *GPT 1 Dominant Hand Peg Insertion Normative Conversion Table: for 14- to 15-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	<49
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	49
126-127	96	67-68		1.75	50
124-125	95	66	15	1.65	
123	94			1.56	51
122	93	65		1.48	
121	92	64		1.41	52
120	91		14	1.34	53
119	90	63		1.28	54
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	55
	85			1.04	56
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	57
112	79	58		0.81	
	78			0.77	
111	77			0.74	58
	76	57		0.71	59
110	75		12	0.67	
	74			0.64	59
109	73	56		0.61	
	72			0.58	60
	71			0.55	61
108	70			0.52	62
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	63
105	63		11	0.33	
	62	53		0.31	64
104	61			0.28	
	60			0.25	
	59			0.23	65
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	66
	54	51		0.10	
101	53			0.08	
	52			0.05	67
	51			0.03	
100	50	50	10	0	68
100	50	50	10	0	68
	49			-0.03	68
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	69
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	70
	29			-0.55	71
	28			-0.58	72
91	27	44		-0.61	
	26			-0.64	73
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	74
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	75
	15			-1.04	76
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	77
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	78
77	6			-1.56	
75-76	5	34	5	-1.65	79
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	80
61-67	1	24-27	3	-2.33	81
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>81

Note. Raw score completion times are presented in seconds; Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 30) included right-handed, female and male, Afrikaans- and English-speaking, coloured and white participants with 7 to 10 years of education.

Table 30. *GPT 1 Dominant Hand Peg Insertion Normative Conversion Table: for 14- to 15-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	<55
133-139	99	73-76	17	2.33	55
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	56
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	57
122	93	65		1.48	58
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	59
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	60
	83			0.95	
114	82	59		0.92	
113	81			0.88	61
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	62
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	63
	71			0.55	64
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	65
	65			0.39	
	64			0.36	66
105	63		11	0.33	67
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	67
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	68
100	50	50	10	0	69

Std	%ile	T	SS	z	Raw
100	50	50	10	0	69
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	69
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	70
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	71
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	72
	29			-0.55	73
	28			-0.58	
91	27	44		-0.61	74
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	75
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	76
87	19			-0.88	77
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	78
84	14	39		-1.08	79
83	13			-1.13	80
82	12	38		-1.18	
	11			-1.23	81
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	82
75-76	5	34	5	-1.65	83
73-74	4	32-33		-1.75	84
71-72	3	31		-1.88	86
68-70	2	28-30	4	-2.05	88
61-67	1	24-27	3	-2.33	91
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>91

Note. Raw score completion times are presented in seconds; Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 63) included right-handed, female and male, Afrikaans- and English-speaking, coloured participants with 7 to 10 years of education.

Table 31. *GPT 1 Nondominant Hand Peg Insertion Normative Conversion Table: for 12- to 13-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	<58
133-139	99	73-76	17	2.33	58
130-132	98	70-72	16	2.05	60
128-129	97	69		1.88	62
126-127	96	67-68		1.75	63
124-125	95	66	15	1.65	
123	94			1.56	64
122	93	65		1.48	
121	92	64		1.41	65
120	91		14	1.34	66
119	90	63		1.28	67
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	68
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	69
	76	57		0.71	70
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	71
108	70			0.52	
	69	55		0.50	72
107	68			0.47	
	67			0.44	
106	66	54		0.41	73
	65			0.39	
	64			0.36	
105	63		11	0.33	74
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	75
103	58	52		0.20	76
	57			0.18	
	56			0.15	
102	55			0.13	77
	54	51		0.10	
101	53			0.08	78
	52			0.05	
	51			0.03	
100	50	50	10	0	79

Std	%ile	T	SS	z	Raw
100	50	50	10	0	79
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	79
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	80
95	37		9	-0.33	81
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	82
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	83
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	84
	24	43		-0.71	85
89	23			-0.74	86
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	87
87	19			-0.88	88
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	89
82	12	38		-1.18	90
	11			-1.23	
81	10	37		-1.28	91
80	9		6	-1.34	92
79	8	36		-1.41	93
78	7	35		-1.48	94
77	6			-1.56	96
75-76	5	34	5	-1.65	97
73-74	4	32-33		-1.75	99
71-72	3	31		-1.88	100
68-70	2	28-30	4	-2.05	101
61-67	1	24-27	3	-2.33	102
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>102

Note. Raw score completion times are presented in seconds; Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 54) included right-handed, female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 8 years of education.

Table 32. *GPT 1 Nondominant Hand Peg Insertion Normative Conversion Table: for 12- to 13-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	<66
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	66
128-129	97	69		1.88	
126-127	96	67-68		1.75	67
124-125	95	66	15	1.65	
123	94			1.56	68
122	93	65		1.48	
121	92	64		1.41	69
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	70
	85			1.04	72
115	84	60	13	0.99	73
	83			0.95	75
114	82	59		0.92	76
113	81			0.88	77
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	78
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	79
	69	55		0.50	
107	68			0.47	
	67			0.44	80
106	66	54		0.41	81
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	82
104	61			0.28	
	60			0.25	83
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	84
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	85
	51			0.03	
100	50	50	10	0	86
100	50	50	10	0	
	49			-0.03	86
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	87
	44			-0.15	
	43			-0.18	88
97	42	48		-0.20	
	41			-0.23	89
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	90
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	91
92	30			-0.52	92
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	93
90	25		8	-0.67	94
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	95
85	16	40	7	-0.99	
	15			-1.04	96
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	97
80	9		6	-1.34	98
79	8	36		-1.41	99
78	7	35		-1.48	100
77	6			-1.56	
75-76	5	34	5	-1.65	101
73-74	4	32-33		-1.75	102
71-72	3	31		-1.88	104
68-70	2	28-30	4	-2.05	106
61-67	1	24-27	3	-2.33	143
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>143

Note. Raw score completion times are presented in seconds; Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 47) included right-handed, female and male, Afrikaans- and English-speaking, coloured participants with 5 to 8 years of education.

Table 33. *GPT 1 Nondominant Hand Peg Insertion Normative Conversion Table: for 14- to 15-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77- ≥80	18 - ≥19	> 2.67	<51
133-139	99	73-76	17	2.33	51
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	52
126-127	96	67-68		1.75	53
124-125	95	66	15	1.65	
123	94			1.56	54
122	93	65		1.48	55
121	92	64		1.41	
120	91		14	1.34	56
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	57
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	58
113	81			0.88	59
	80			0.84	60
112	79	58		0.81	61
	78			0.77	62
111	77			0.74	63
	76	57		0.71	
110	75		12	0.67	64
	74			0.64	65
109	73	56		0.61	66
	72			0.58	
	71			0.55	67
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	68
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	69
	59			0.23	
103	58	52		0.20	
	57			0.18	70
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	71
	51			0.03	
100	50	50	10	0	72
100	50	50	10	0	72
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	72
98	45			-0.13	
	44			-0.15	73
	43			-0.18	74
97	42	48		-0.20	75
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	76
	35			-0.39	77
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	78
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	79
	26			-0.64	
90	25		8	-0.67	80
	24	43		-0.71	
89	23			-0.74	81
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	82
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	83
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	84
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	85
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	86
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	87
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>87

Note. Raw score completion times are presented in seconds; Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 30) included right-handed, female and male, Afrikaans- and English-speaking, coloured and white participants with 7 to 10 years of education.

Table 34. *GPT 1 Nondominant Hand Peg Insertion Normative Conversion Table: for 14- to 15-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77- ≥80	18 - ≥19	> 2.67	<23
133-139	99	73-76	17	2.33	36
130-132	98	70-72	16	2.05	57
128-129	97	69		1.88	58
126-127	96	67-68		1.75	59
124-125	95	66	15	1.65	60
123	94			1.56	61
122	93	65		1.48	62
121	92	64		1.41	
120	91		14	1.34	63
119	90	63		1.28	65
	89			1.23	
118	88	62		1.18	66
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	67
	80			0.84	
112	79	58		0.81	68
	78			0.77	
111	77			0.74	69
	76	57		0.71	
110	75		12	0.67	
	74			0.64	70
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	71
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	72
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	73
	60			0.25	
	59			0.23	
103	58	52		0.20	74
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	75
	52			0.05	76
	51			0.03	
100	50	50	10	0	77

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	77
	48			-0.05	78
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	79
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	80
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	81
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	82
	28			-0.58	83
91	27	44		-0.61	84
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	85
	22			-0.77	
88	21	42		-0.81	86
	20			-0.84	
87	19			-0.88	87
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	88
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	89
80	9		6	-1.34	90
79	8	36		-1.41	91
78	7	35		-1.48	92
77	6			-1.56	93
75-76	5	34	5	-1.65	94
73-74	4	32-33		-1.75	95
71-72	3	31		-1.88	96
68-70	2	28-30	4	-2.05	97
61-67	1	24-27	3	-2.33	103
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>103

Note. Raw score completion times are presented in seconds; Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 63) included right-handed, female and male, Afrikaans- and English-speaking, coloured participants with 7 to 10 years of education.

Table 35. *GPT 2 Dominant Hand Peg Removal Normative Conversion Table: for the whole sample*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77- ≥80	18 - ≥19	> 2.67	<17
133-139	99	73-76	17	2.33	17
130-132	98	70-72	16	2.05	18
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	19
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	20
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	21
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	22
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	23
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	24
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	25
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	26
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	27
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	28
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	29
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	30
75-76	5	34	5	-1.65	31-32
73-74	4	32-33		-1.75	33-34
71-72	3	31		-1.88	35
68-70	2	28-30	4	-2.05	36-39
61-67	1	24-27	3	-2.33	40
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>40

Note. Raw score completion times are presented in seconds; Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 194) included right-handed, female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 10 years of advantaged and disadvantaged quality of education.

Table 36. *GPT 2 Nondominant Hand Peg Removal Normative Conversion Table: for the whole sample*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	<18
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	18
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	19
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	20
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	21
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	22
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	23
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	24
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	25
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	26
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	27
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	28
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	29
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	30
79	8	36		-1.41	
78	7	35		-1.48	31
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	32
71-72	3	31		-1.88	33
68-70	2	28-30	4	-2.05	34
61-67	1	24-27	3	-2.33	38
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>38

Note. Raw score completion times are presented in seconds; Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 194) included right-handed, female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 10 years of advantaged and disadvantaged quality of education.

Table 37. *MAVLT Trial 1 Normative Conversion Table: for the whole sample*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	>12
133-139	99	73-76	17	2.33	12
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	11
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	10
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	9
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	8
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	7
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	6
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	5
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	4
61-67	1	24-27	3	-2.33	3
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<3

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 215) included 12- to 15-year-old, female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 10 years of advantaged and disadvantaged quality of education.

Table 38. *MAVLT Trial 5 Normative Conversion Table: for participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	15
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	14
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	13
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	12
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	11
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	10
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	9
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-8

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 94) included 12- to 15-year-old, female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 10 years of education.

Table 39. *MAVLT Trial 5 Normative Conversion Table: for participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	15
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	14
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	13
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	12
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	11
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	10
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	9
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-8

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 121) included 12- to 15-year-old, female and male, Afrikaans- and English-speaking, coloured participants with 5 to 10 years of education.

Table 40. *MAVLT Immediate Recall Normative Conversion Table: for participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	15
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	14
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	13
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	12
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	11
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	10
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	9
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	8
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-7

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 94) included 12- to 15-year-old, female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 10 years of education.

Table 41. *MAVLT Immediate Recall Normative Conversion Table: for participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 -≥19	> 2.67	
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	15
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	14
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	13
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	12
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	11
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	10
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	9
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	8
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	7
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	6
61-67	1	24-27	3	-2.33	5
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-4

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 121) included 12- to 15-year-old, female and male, Afrikaans- and English-speaking, coloured participants with 5 to 10 years of education.

Table 42. *MAVLT Delayed Recall Normative Conversion Table: for participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	15
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	14
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	13
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	12
	26			-0.64	
90	25		8	-0.67	11
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	10
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	9
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	8
68-70	2	28-30	4	-2.05	6-7
61-67	1	24-27	3	-2.33	5
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-4

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 94) included 12- to 15-year-old, female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 10 years of education.

Table 43. *MAVLT Delayed Recall Normative Conversion Table: for participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	15
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	14
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	13
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	12
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	11

Std	%ile	T	SS	z	Raw
100	50	50	10	0	11
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	10
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	9
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	8
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	7
61-67	1	24-27	3	-2.33	6
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-5

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 121) included 12- to 15-year-old, female and male, Afrikaans- and English-speaking, coloured participants with 5 to 10 years of education.

Table 44. *MAVLT Learning Rate Normative Conversion Table: for the whole sample*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	
133-139	99	73-76	17	2.33	>10
130-132	98	70-72	16	2.05	10
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	9
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	8
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	7
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	6

Std	%ile	T	SS	z	Raw
100	50	50	10	0	6
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	5
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	4
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	3
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	2
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	1
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 215) included 12- to 15-year-old, female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 10 years of advantaged and disadvantaged quality of education.

Table 45. *MAVLT Forgetting Rate Normative Conversion Table: for the whole sample*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	<-3
133-139	99	73-76	17	2.33	-3
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	-2
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	-1
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	0
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	1
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	2
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	3
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	4
68-70	2	28-30	4	-2.05	5
61-67	1	24-27	3	-2.33	>5
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 215) included 12- to 15-year-old, female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 10 years of advantaged and disadvantaged quality of education.

Table 46. *MAVLT Recognition Normative Conversion Table: for the whole sample*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	30
100	50	50	10	0	30
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	29
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	28
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	27
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	26
61-67	1	24-27	3	-2.33	25
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-24

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 215) included 12- to 15-year-old, female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 10 years of advantaged and disadvantaged quality of education.

Table 47. *ROCFT Copy Time Normative Conversion Table: for female participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	<86
133-139	99	73-76	17	2.33	86
130-132	98	70-72	16	2.05	120
128-129	97	69		1.88	121
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	122
122	93	65		1.48	
121	92	64		1.41	123
120	91		14	1.34	
119	90	63		1.28	124
	89			1.23	128
118	88	62		1.18	131
117	87			1.13	133
116	86	61		1.08	135
	85			1.04	136
115	84	60	13	0.99	137
	83			0.95	138
114	82	59		0.92	139
113	81			0.88	
	80			0.84	140
112	79	58		0.81	141
	78			0.77	142
111	77			0.74	144
	76	57		0.71	145
110	75		12	0.67	146
	74			0.64	147
109	73	56		0.61	148
	72			0.58	149
	71			0.55	150
108	70			0.52	151
	69	55		0.50	152
107	68			0.47	153
	67			0.44	154
106	66	54		0.41	155
	65			0.39	156
	64			0.36	157
105	63		11	0.33	158
	62	53		0.31	159
104	61			0.28	161
	60			0.25	162
	59			0.23	
103	58	52		0.20	163
	57			0.18	
	56			0.15	164
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	165
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	166
99	47			-0.08	167
	46	49		-0.10	168
98	45			-0.13	
	44			-0.15	169
	43			-0.18	172
97	42	48		-0.20	174
	41			-0.23	175
	40			-0.25	176
96	39			-0.28	
	38	47		-0.31	177
95	37		9	-0.33	179
	36			-0.36	180
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	181
	31	45		-0.50	183
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	184
90	25		8	-0.67	186
	24	43		-0.71	187
89	23			-0.74	
	22			-0.77	188
88	21	42		-0.81	189
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	190
	15			-1.04	191
84	14	39		-1.08	192
83	13			-1.13	197
82	12	38		-1.18	202
	11			-1.23	204
81	10	37		-1.28	205
80	9		6	-1.34	215
79	8	36		-1.41	224
78	7	35		-1.48	229
77	6			-1.56	233
75-76	5	34	5	-1.65	248
73-74	4	32-33		-1.75	263
71-72	3	31		-1.88	266
68-70	2	28-30	4	-2.05	268
61-67	1	24-27	3	-2.33	320
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>320

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 51) included 12- to 15-year-old, Afrikaans- and English-speaking, coloured and white participants with 5 to 10 years of education.

Table 48. *ROCFT Copy Time Normative Conversion Table: for female participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	<92
133-139	99	73-76	17	2.33	92
130-132	98	70-72	16	2.05	95
128-129	97	69		1.88	96
126-127	96	67-68		1.75	103
124-125	95	66	15	1.65	
123	94			1.56	107
122	93	65		1.48	109
121	92	64		1.41	114
120	91		14	1.34	121
119	90	63		1.28	
	89			1.23	123
118	88	62		1.18	124
117	87			1.13	132
116	86	61		1.08	138
	85			1.04	
115	84	60	13	0.99	
	83			0.95	139
114	82	59		0.92	140
113	81			0.88	144
	80			0.84	
112	79	58		0.81	147
	78			0.77	148
111	77			0.74	
	76	57		0.71	149
110	75		12	0.67	151
	74			0.64	152
109	73	56		0.61	
	72			0.58	153
	71			0.55	155
108	70			0.52	159
	69	55		0.50	160
107	68			0.47	161
	67			0.44	162
106	66	54		0.41	163
	65			0.39	164
	64			0.36	
105	63		11	0.33	166
	62	53		0.31	167
104	61			0.28	
	60			0.25	168
	59			0.23	169
103	58	52		0.20	170
	57			0.18	171
	56			0.15	
102	55			0.13	172
	54	51		0.10	175
101	53			0.08	179
	52			0.05	
	51			0.03	
100	50	50	10	0	180

Std	%ile	T	SS	z	Raw
100	50	50	10	0	180
	49			-0.03	181
	48			-0.05	
99	47			-0.08	182
	46	49		-0.10	184
98	45			-0.13	185
	44			-0.15	186
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	187
	40			-0.25	189
96	39			-0.28	191
	38	47		-0.31	192
95	37		9	-0.33	193
	36			-0.36	194
	35			-0.39	196
94	34	46		-0.41	197
	33			-0.44	
93	32			-0.47	198
	31	45		-0.50	201
92	30			-0.52	203
	29			-0.55	204
	28			-0.58	206
91	27	44		-0.61	209
	26			-0.64	211
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	212
88	21	42		-0.81	214
	20			-0.84	218
87	19			-0.88	219
86	18	41		-0.92	220
	17			-0.95	222
85	16	40	7	-0.99	225
	15			-1.04	228
84	14	39		-1.08	231
83	13			-1.13	
82	12	38		-1.18	232
	11			-1.23	234
81	10	37		-1.28	236
80	9		6	-1.34	239
79	8	36		-1.41	260
78	7	35		-1.48	270
77	6			-1.56	273
75-76	5	34	5	-1.65	281
73-74	4	32-33		-1.75	288
71-72	3	31		-1.88	294
68-70	2	28-30	4	-2.05	312
61-67	1	24-27	3	-2.33	323
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>323

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 66) included 12- to 15-year-old, Afrikaans- and English-speaking, coloured participants with 5 to 10 years of education.

Table 49. *ROCFT Copy Time Normative Conversion Table: for male participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	<104
133-139	99	73-76	17	2.33	104
130-132	98	70-72	16	2.05	113
128-129	97	69		1.88	
126-127	96	67-68		1.75	117
124-125	95	66	15	1.65	118
123	94			1.56	
122	93	65		1.48	119
121	92	64		1.41	122
120	91		14	1.34	126
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	128
117	87			1.13	129
116	86	61		1.08	
	85			1.04	131
115	84	60	13	0.99	132
	83			0.95	133
114	82	59		0.92	135
113	81			0.88	137
	80			0.84	139
112	79	58		0.81	142
	78			0.77	144
111	77			0.74	146
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	147
	72			0.58	148
	71			0.55	149
108	70			0.52	151
	69	55		0.50	153
107	68			0.47	154
	67			0.44	156
106	66	54		0.41	157
	65			0.39	158
	64			0.36	159
105	63		11	0.33	160
	62	53		0.31	161
104	61			0.28	162
	60			0.25	163
	59			0.23	164
103	58	52		0.20	
	57			0.18	165
	56			0.15	167
102	55			0.13	169
	54	51		0.10	172
101	53			0.08	175
	52			0.05	177
	51			0.03	179
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	180
99	47			-0.08	
	46	49		-0.10	181
98	45			-0.13	182
	44			-0.15	183
	43			-0.18	184
97	42	48		-0.20	185
	41			-0.23	186
	40			-0.25	187
96	39			-0.28	
	38	47		-0.31	188
95	37		9	-0.33	190
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	192
	33			-0.44	193
93	32			-0.47	195
	31	45		-0.50	198
92	30			-0.52	199
	29			-0.55	200
	28			-0.58	203
91	27	44		-0.61	206
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	209
89	23			-0.74	210
	22			-0.77	211
88	21	42		-0.81	214
	20			-0.84	219
87	19			-0.88	223
86	18	41		-0.92	225
	17			-0.95	226
85	16	40	7	-0.99	232
	15			-1.04	239
84	14	39		-1.08	244
83	13			-1.13	
82	12	38		-1.18	245
	11			-1.23	248
81	10	37		-1.28	251
80	9		6	-1.34	255
79	8	36		-1.41	260
78	7	35		-1.48	266
77	6			-1.56	276
75-76	5	34	5	-1.65	287
73-74	4	32-33		-1.75	291
71-72	3	31		-1.88	292
68-70	2	28-30	4	-2.05	295
61-67	1	24-27	3	-2.33	299
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>299

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 43) included 12- to 15-year-old, Afrikaans- and English-speaking, coloured and white participants with 5 to 10 years of education.

Table 50. *ROCFT Copy Time Normative Conversion Table: for male participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	<99
133-139	99	73-76	17	2.33	99
130-132	98	70-72	16	2.05	110
128-129	97	69		1.88	116
126-127	96	67-68		1.75	121
124-125	95	66	15	1.65	126
123	94			1.56	129
122	93	65		1.48	131
121	92	64		1.41	133
120	91		14	1.34	
119	90	63		1.28	134
	89			1.23	135
118	88	62		1.18	138
117	87			1.13	
116	86	61		1.08	
	85			1.04	142
115	84	60	13	0.99	143
	83			0.95	144
114	82	59		0.92	147
113	81			0.88	148
	80			0.84	149
112	79	58		0.81	150
	78			0.77	151
111	77			0.74	153
	76	57		0.71	155
110	75		12	0.67	156
	74			0.64	157
109	73	56		0.61	158
	72			0.58	160
	71			0.55	163
108	70			0.52	166
	69	55		0.50	170
107	68			0.47	174
	67			0.44	177
106	66	54		0.41	178
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	179
	60			0.25	180
	59			0.23	183
103	58	52		0.20	192
	57			0.18	199
	56			0.15	201
102	55			0.13	203
	54	51		0.10	204
101	53			0.08	205
	52			0.05	207
	51			0.03	208
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	209
99	47			-0.08	
	46	49		-0.10	210
98	45			-0.13	211
	44			-0.15	212
	43			-0.18	213
97	42	48		-0.20	214
	41			-0.23	215
	40			-0.25	218
96	39			-0.28	
	38	47		-0.31	222
95	37		9	-0.33	223
	36			-0.36	225
	35			-0.39	228
94	34	46		-0.41	230
	33			-0.44	235
93	32			-0.47	242
	31	45		-0.50	
92	30			-0.52	246
	29			-0.55	247
	28			-0.58	250
91	27	44		-0.61	252
	26			-0.64	254
90	25		8	-0.67	
	24	43		-0.71	255
89	23			-0.74	257
	22			-0.77	258
88	21	42		-0.81	
	20			-0.84	259
87	19			-0.88	260
86	18	41		-0.92	261
	17			-0.95	264
85	16	40	7	-0.99	270
	15			-1.04	278
84	14	39		-1.08	287
83	13			-1.13	298
82	12	38		-1.18	319
	11			-1.23	339
81	10	37		-1.28	343
80	9		6	-1.34	344
79	8	36		-1.41	346
78	7	35		-1.48	348
77	6			-1.56	356
75-76	5	34	5	-1.65	369
73-74	4	32-33		-1.75	383
71-72	3	31		-1.88	396
68-70	2	28-30	4	-2.05	476
61-67	1	24-27	3	-2.33	584
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>600

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 55) included 12- to 15-year-old, Afrikaans- and English-speaking, coloured participants with 5 to 10 years of education.

Table 51. *ROCFT Copy Normative Conversion Table: for 12-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77- ≥80	18 - ≥19	> 2.67	
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	36
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	35.5
123	94			1.56	35
122	93	65		1.48	
121	92	64		1.41	34.5
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	34
116	86	61		1.08	
	85			1.04	33.5
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	33
	59			0.23	32.5
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	32
	43			-0.18	
97	42	48		-0.20	31.5
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	31
	36			-0.36	
	35			-0.39	30.5
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	30
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	29.5
	26			-0.64	
90	25		8	-0.67	29
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	28.5
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	28
83	13			-1.13	
82	12	38		-1.18	27.5
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	26.5-27
71-72	3	31		-1.88	25-26
68-70	2	28-30	4	-2.05	23-24.5
61-67	1	24-27	3	-2.33	22.5
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-22

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 31) included female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 7 years of education.

Table 52. *ROCFT Copy Normative Conversion Table: for 12-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	36
126-127	96	67-68		1.75	35.5
124-125	95	66	15	1.65	
123	94			1.56	35
122	93	65		1.48	34.5
121	92	64		1.41	
120	91		14	1.34	34
119	90	63		1.28	33.5
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	33
115	84	60	13	0.99	32.5
	83			0.95	
114	82	59		0.92	32
113	81			0.88	
	80			0.84	
112	79	58		0.81	31.5
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	31
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	30.5
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	30
98	45			-0.13	
	44			-0.15	29.5
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	29
	36			-0.36	
	35			-0.39	28.5
94	34	46		-0.41	28
	33			-0.44	27.5
93	32			-0.47	27
	31	45		-0.50	26.5
92	30			-0.52	
	29			-0.55	
	28			-0.58	26
91	27	44		-0.61	
	26			-0.64	25.5
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	25
88	21	42		-0.81	24.5
	20			-0.84	24
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	23.5
82	12	38		-1.18	
	11			-1.23	23
81	10	37		-1.28	22.5
80	9		6	-1.34	22
79	8	36		-1.41	21.5
78	7	35		-1.48	21
77	6			-1.56	20.5
75-76	5	34	5	-1.65	20
73-74	4	32-33		-1.75	19.5
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	19
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-18.5

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 34) included female and male, Afrikaans- and English-speaking, coloured participants with 5 to 7 years of education.

Table 53. *ROCFT Copy Normative Conversion Table: for 13- to 15-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	36
124-125	95	66	15	1.65	
123	94			1.56	35.5
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	35
110	75		12	0.67	34.5
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	34
	54	51		0.10	33.5
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	33
95	37		9	-0.33	
	36			-0.36	32.5
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	32
90	25		8	-0.67	31.5
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	31
	17			-0.95	30.5
85	16	40	7	-0.99	
	15			-1.04	30
84	14	39		-1.08	
83	13			-1.13	29.5
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	29
77	6			-1.56	28.5
75-76	5	34	5	-1.65	28
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	27.5
61-67	1	24-27	3	-2.33	27
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-26.5

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 63) included female and male, Afrikaans- and English-speaking, coloured and white participants with 6 to 10 years of education.

Table 54. *ROCFT Copy Normative Conversion Table: for 13- to 15-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	36
128-129	97	69		1.88	35.5
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	35
	89			1.23	34.5
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	34
112	79	58		0.81	
	78			0.77	33.5
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	33
	67			0.44	32.5
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	32
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	31
	40			-0.25	30.5
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	30
	36			-0.36	29.5
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	29
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	28.5
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	28
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	27.5
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	27
	11			-1.23	26.5
81	10	37		-1.28	26
80	9		6	-1.34	25.5
79	8	36		-1.41	
78	7	35		-1.48	25
77	6			-1.56	24-24.5
75-76	5	34	5	-1.65	23-23.5
73-74	4	32-33		-1.75	22.5
71-72	3	31		-1.88	21.5-22
68-70	2	28-30	4	-2.05	19-21
61-67	1	24-27	3	-2.33	18.5
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-18

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 87) included female and male, Afrikaans- and English-speaking, coloured participants with 6 to 10 years of education.

Table 55. *ROCFT OSS Normative Conversion Table: for 12-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	7
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	6
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	5
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	4
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	3
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	1-2

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 31) included female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 7 years of education.

Table 56. *ROCFT OSS Normative Conversion Table: for 12-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	7
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	6
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	5
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	4
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	3
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	2
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	1

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 34) included female and male, Afrikaans- and English-speaking, coloured participants with 5 to 7 years of education.

Table 57. *ROCFT OSS Normative Conversion Table: for 13- to 15-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	7
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	6
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	5
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	4
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	3
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	1-2

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 63) included female and male, Afrikaans- and English-speaking, coloured and white participants with 6 to 10 years of education.

Table 58. *ROCFT OSS Normative Conversion Table: for 13- to 15-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	7
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	6
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	5
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	4
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	3
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	2
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	1

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 87) included female and male, Afrikaans- and English-speaking, coloured participants with 6 to 10 years of education.

Table 59. *ROCFT Immediate Recall Normative Conversion Table: for 12-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	29-36
133-139	99	73-76	17	2.33	28.5
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	28
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	27.5
122	93	65		1.48	27
121	92	64		1.41	
120	91		14	1.34	26.5
119	90	63		1.28	26
	89			1.23	
118	88	62		1.18	
117	87			1.13	25.5
116	86	61		1.08	
	85			1.04	25
115	84	60	13	0.99	
	83			0.95	24.5
114	82	59		0.92	
113	81			0.88	
	80			0.84	24
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	23.5
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	23
106	66	54		0.41	
	65			0.39	22.5
	64			0.36	
105	63		11	0.33	22
	62	53		0.31	
104	61			0.28	
	60			0.25	21.5
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	21

Std	%ile	T	SS	z	Raw
100	50	50	10	0	21
	49			-0.03	20.5
	48			-0.05	20
99	47			-0.08	19.5
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	19
96	39			-0.28	18.5
	38	47		-0.31	
95	37		9	-0.33	18
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	17.5
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	17
	29			-0.55	16.5
	28			-0.58	
91	27	44		-0.61	16
	26			-0.64	15.5
90	25		8	-0.67	15
	24	43		-0.71	14.5
89	23			-0.74	14
	22			-0.77	
88	21	42		-0.81	13.5
	20			-0.84	13
87	19			-0.88	12.5
86	18	41		-0.92	
	17			-0.95	12
85	16	40	7	-0.99	
	15			-1.04	11.5
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	11
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	10.5
77	6			-1.56	
75-76	5	34	5	-1.65	10
73-74	4	32-33		-1.75	9-9.5
71-72	3	31		-1.88	7-8.5
68-70	2	28-30	4	-2.05	5-6.5
61-67	1	24-27	3	-2.33	4.5
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-4

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 31) included female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 7 years of education.

Table 60. *ROCFT Immediate Recall Normative Conversion Table: for 12-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	25-36
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	24.5
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	24
122	93	65		1.48	23.5
121	92	64		1.41	
120	91		14	1.34	23
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	22.5
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	22
	78			0.77	21.5
111	77			0.74	
	76	57		0.71	21
110	75		12	0.67	20.5
	74			0.64	
109	73	56		0.61	20
	72			0.58	19.5
	71			0.55	19
108	70			0.52	18.5
	69	55		0.50	
107	68			0.47	
	67			0.44	18
106	66	54		0.41	
	65			0.39	
	64			0.36	17.5
105	63		11	0.33	
	62	53		0.31	17
104	61			0.28	16.5
	60			0.25	
	59			0.23	
103	58	52		0.20	16
	57			0.18	
	56			0.15	
102	55			0.13	15.5
	54	51		0.10	
101	53			0.08	
	52			0.05	15
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	14.5
	48			-0.05	
99	47			-0.08	14
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	13.5
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	13
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	12.5
	36			-0.36	
	35			-0.39	12
94	34	46		-0.41	11.5
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	11
92	30			-0.52	
	29			-0.55	10.5
	28			-0.58	10
91	27	44		-0.61	
	26			-0.64	9.5
90	25		8	-0.67	9
	24	43		-0.71	8.5
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	8
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	7.5
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	7
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	6.5
75-76	5	34	5	-1.65	6
73-74	4	32-33		-1.75	5.5
71-72	3	31		-1.88	5
68-70	2	28-30	4	-2.05	4.5
61-67	1	24-27	3	-2.33	4
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-3.5

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 34) included female and male, Afrikaans- and English-speaking, coloured participants with 5 to 7 years of education.

Table 61. *ROCFT Immediate Recall Normative Conversion Table: for 13- to 15-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77- ≥80	18 - ≥19	> 2.67	35.5-36
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	35
126-127	96	67-68		1.75	33-34
124-125	95	66	15	1.65	31-32.5
123	94			1.56	30.5
122	93	65		1.48	30
121	92	64		1.41	29.5
120	91		14	1.34	29
119	90	63		1.28	28.5
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	28
114	82	59		0.92	27.5
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	27
111	77			0.74	26.5
	76	57		0.71	26
110	75		12	0.67	25.5
	74			0.64	25
109	73	56		0.61	24.5
	72			0.58	
	71			0.55	
108	70			0.52	24
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	23.5
	65			0.39	
	64			0.36	
105	63		11	0.33	23
	62	53		0.31	
104	61			0.28	
	60			0.25	22.5
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	22
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	21.5
	46	49		-0.10	21
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	20.5
	41			-0.23	
	40			-0.25	
96	39			-0.28	20
	38	47		-0.31	19-19.5
95	37		9	-0.33	
	36			-0.36	18.5
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	18
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	17.5
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	17
	17			-0.95	
85	16	40	7	-0.99	16.5
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	16
82	12	38		-1.18	15.5
	11			-1.23	15
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	14.5
77	6			-1.56	
75-76	5	34	5	-1.65	14
73-74	4	32-33		-1.75	13-13.5
71-72	3	31		-1.88	12.5
68-70	2	28-30	4	-2.05	12
61-67	1	24-27	3	-2.33	11.5
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-11

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 63) included female and male, Afrikaans- and English-speaking, coloured and white participants with 6 to 10 years of education.

Table 62. *ROCFT Immediate Recall Normative Conversion Table: for 13- to 15-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	31.5-36
133-139	99	73-76	17	2.33	30.5-31
130-132	98	70-72	16	2.05	30
128-129	97	69		1.88	29.5
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	29
122	93	65		1.48	28.5
121	92	64		1.41	
120	91		14	1.34	28
119	90	63		1.28	27.5
	89			1.23	
118	88	62		1.18	27
117	87			1.13	26.5
116	86	61		1.08	26
	85			1.04	25.5
115	84	60	13	0.99	25
	83			0.95	24.5
114	82	59		0.92	
113	81			0.88	24
	80			0.84	23.5
112	79	58		0.81	23
	78			0.77	22.5
111	77			0.74	22
	76	57		0.71	21.5
110	75		12	0.67	
	74			0.64	21
109	73	56		0.61	20.5
	72			0.58	
	71			0.55	
108	70			0.52	20
	69	55		0.50	19.5
107	68			0.47	
	67			0.44	
106	66	54		0.41	19
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	18.5
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	18
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	17.5
98	45			-0.13	
	44			-0.15	17
	43			-0.18	16.5
97	42	48		-0.20	16
	41			-0.23	
	40			-0.25	15.5
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	15
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	14.5
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	14
	26			-0.64	
90	25		8	-0.67	13.5
	24	43		-0.71	
89	23			-0.74	13
	22			-0.77	
88	21	42		-0.81	12.5
	20			-0.84	12
87	19			-0.88	
86	18	41		-0.92	11.5
	17			-0.95	11
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	10.5
82	12	38		-1.18	10
	11			-1.23	
81	10	37		-1.28	9.5
80	9		6	-1.34	
79	8	36		-1.41	9
78	7	35		-1.48	8.5
77	6			-1.56	8
75-76	5	34	5	-1.65	7.5
73-74	4	32-33		-1.75	7
71-72	3	31		-1.88	6.5
68-70	2	28-30	4	-2.05	6
61-67	1	24-27	3	-2.33	5.5
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-5

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 87) included female and male, Afrikaans- and English-speaking, coloured participants with 6 to 10 years of education.

Table 63. *ROCFT Delayed Recall Normative Conversion Table: for 12-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77- ≥80	18 - ≥19	> 2.67	31-36
133-139	99	73-76	17	2.33	30.5
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	30
122	93	65		1.48	29.5
121	92	64		1.41	28-29
120	91		14	1.34	27.5
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	27
116	86	61		1.08	
	85			1.04	26.5
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	26
	76	57		0.71	
110	75		12	0.67	25.5
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	25
	69	55		0.50	24.5
107	68			0.47	
	67			0.44	24
106	66	54		0.41	
	65			0.39	23.5
	64			0.36	23
105	63		11	0.33	
	62	53		0.31	22.5
104	61			0.28	
	60			0.25	22
	59			0.23	21.5
103	58	52		0.20	
	57			0.18	21
	56			0.15	20.5
102	55			0.13	20
	54	51		0.10	19.5
101	53			0.08	19
	52			0.05	18.5
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	18
	46	49		-0.10	
98	45			-0.13	17.5
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	17
96	39			-0.28	16.5
	38	47		-0.31	
95	37		9	-0.33	16
	36			-0.36	
	35			-0.39	15.5
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	15
	29			-0.55	14.5
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	14
89	23			-0.74	
	22			-0.77	13.5
88	21	42		-0.81	
	20			-0.84	13
87	19			-0.88	
86	18	41		-0.92	12.5
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	12
83	13			-1.13	11
82	12	38		-1.18	10
	11			-1.23	9.5
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	9
77	6			-1.56	
75-76	5	34	5	-1.65	8.5
73-74	4	32-33		-1.75	8
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	7.5
61-67	1	24-27	3	-2.33	7
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-6

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 31) included female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 7 years of education.

Table 64. *ROCFT Delayed Recall Normative Conversion Table: for 12-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	28-36
133-139	99	73-76	17	2.33	27.5
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	27
122	93	65		1.48	26.5
121	92	64		1.41	
120	91		14	1.34	26
119	90	63		1.28	
	89			1.23	25.5
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	25
114	82	59		0.92	24.5
113	81			0.88	24
	80			0.84	23.5
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	23
110	75		12	0.67	22.5
	74			0.64	
109	73	56		0.61	22
	72			0.58	21.5
	71			0.55	
108	70			0.52	21
	69	55		0.50	
107	68			0.47	20.5
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	20
	60			0.25	19.5
	59			0.23	19
103	58	52		0.20	18.5
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	18
98	45			-0.13	
	44			-0.15	17.5
	43			-0.18	17
97	42	48		-0.20	16.5
	41			-0.23	16
	40			-0.25	15.5
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	15
92	30			-0.52	
	29			-0.55	14.5
	28			-0.58	14
91	27	44		-0.61	
	26			-0.64	13.5
90	25		8	-0.67	13
	24	43		-0.71	
89	23			-0.74	12.5
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	12
79	8	36		-1.41	11.5
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	11
68-70	2	28-30	4	-2.05	10
61-67	1	24-27	3	-2.33	9.5
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-9

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 34) included female and male, Afrikaans- and English-speaking, coloured participants with 5 to 7 years of education.

Table 65. *ROCFT Delayed Recall Normative Conversion Table: for 13- to 15-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	29-36
133-139	99	73-76	17	2.33	28.5
130-132	98	70-72	16	2.05	28
128-129	97	69		1.88	27.5
126-127	96	67-68		1.75	27
124-125	95	66	15	1.65	26-26.5
123	94			1.56	25.5
122	93	65		1.48	25
121	92	64		1.41	24.5
120	91		14	1.34	24
119	90	63		1.28	23.5
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	23
	80			0.84	22.5
112	79	58		0.81	
	78			0.77	22
111	77			0.74	
	76	57		0.71	21.5
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	21
108	70			0.52	20.5
	69	55		0.50	
107	68			0.47	
	67			0.44	20
106	66	54		0.41	19.5
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	19
	57			0.18	18.5
	56			0.15	
102	55			0.13	
	54	51		0.10	18
101	53			0.08	17.5
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	17
	48			-0.05	16.5
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	16
	43			-0.18	15.5
97	42	48		-0.20	15
	41			-0.23	14.5
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	14
95	37		9	-0.33	13.5
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	13
93	32			-0.47	12.5
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	12
91	27	44		-0.61	11.5
	26			-0.64	
90	25		8	-0.67	11
	24	43		-0.71	10.5
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	10
	20			-0.84	9.5
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	9
85	16	40	7	-0.99	8.5
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	8
	11			-1.23	7.5
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	6.5-7
78	7	35		-1.48	6
77	6			-1.56	5.5
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	5
71-72	3	31		-1.88	4.5
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	4
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-3

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 63) included female and male, Afrikaans- and English-speaking, coloured and white participants with 6 to 10 years of education.

Table 66. *ROCFT Delayed Recall Normative Conversion Table: for 13- to 15-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	34.5-36
133-139	99	73-76	17	2.33	34
130-132	98	70-72	16	2.05	31.5-33.5
128-129	97	69		1.88	31
126-127	96	67-68		1.75	30.5
124-125	95	66	15	1.65	30
123	94			1.56	29.5
122	93	65		1.48	
121	92	64		1.41	29
120	91		14	1.34	28.5
119	90	63		1.28	28
	89			1.23	27.5
118	88	62		1.18	27
117	87			1.13	26.5
116	86	61		1.08	26
	85			1.04	25.5
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	25
112	79	58		0.81	24.5
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	24
	74			0.64	23.5
109	73	56		0.61	
	72			0.58	23
	71			0.55	22.5
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	22
	64			0.36	21.5
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	21
	60			0.25	20.5
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	20
	52			0.05	19.5
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	19
99	47			-0.08	18.5
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	18
	36			-0.36	17.5
	35			-0.39	
94	34	46		-0.41	17
	33			-0.44	16.5
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	16
90	25		8	-0.67	15.5
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	15
85	16	40	7	-0.99	14.5
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	14
	11			-1.23	13.5
81	10	37		-1.28	13
80	9		6	-1.34	12.5
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	11-12
75-76	5	34	5	-1.65	9.5-10
73-74	4	32-33		-1.75	8.5-9
71-72	3	31		-1.88	7.5-8
68-70	2	28-30	4	-2.05	7
61-67	1	24-27	3	-2.33	6.5
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-6

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 87) included female and male, Afrikaans- and English-speaking, coloured participants with 6 to 10 years of education.

Table 67. *SCWT Word Page Normative Conversion Table: for 12-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 -≥19	> 2.67	>108
133-139	99	73-76	17	2.33	106-108
130-132	98	70-72	16	2.05	102-105
128-129	97	69		1.88	101
126-127	96	67-68		1.75	99-100
124-125	95	66	15	1.65	98
123	94			1.56	97
122	93	65		1.48	96
121	92	64		1.41	
120	91		14	1.34	95
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	94
	85			1.04	93
115	84	60	13	0.99	
	83			0.95	92
114	82	59		0.92	
113	81			0.88	91
	80			0.84	
112	79	58		0.81	90
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	89
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	88
	69	55		0.50	87
107	68			0.47	86
	67			0.44	
106	66	54		0.41	
	65			0.39	85
	64			0.36	
105	63		11	0.33	
	62	53		0.31	84
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	83
	54	51		0.10	
101	53			0.08	
	52			0.05	82
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	81
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	80
	41			-0.23	
	40			-0.25	
96	39			-0.28	79
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	78
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	77
	24	43		-0.71	
89	23			-0.74	76
	22			-0.77	
88	21	42		-0.81	75
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	74
84	14	39		-1.08	
83	13			-1.13	73
82	12	38		-1.18	
	11			-1.23	72
81	10	37		-1.28	71
80	9		6	-1.34	69-70
79	8	36		-1.41	68
78	7	35		-1.48	67
77	6			-1.56	66
75-76	5	34	5	-1.65	65
73-74	4	32-33		-1.75	64
71-72	3	31		-1.88	63
68-70	2	28-30	4	-2.05	62
61-67	1	24-27	3	-2.33	61
≤55 -60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<61

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 31) included female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 7 years of education.

Table 68. *SCWT Word Page Normative Conversion Table: for 12-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	>92
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	92
128-129	97	69		1.88	91
126-127	96	67-68		1.75	90
124-125	95	66	15	1.65	88
123	94			1.56	87
122	93	65		1.48	
121	92	64		1.41	86
120	91		14	1.34	85
119	90	63		1.28	84
	89			1.23	83
118	88	62		1.18	
117	87			1.13	82
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	81
113	81			0.88	80
	80			0.84	79
112	79	58		0.81	78
	78			0.77	77
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	76
	74			0.64	
109	73	56		0.61	
	72			0.58	75
	71			0.55	
108	70			0.52	
	69	55		0.50	74
107	68			0.47	
	67			0.44	
106	66	54		0.41	73
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	72
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	71

Std	%ile	T	SS	z	Raw
100	50	50	10	0	71
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	70
	43			-0.18	
97	42	48		-0.20	69
	41			-0.23	68
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	67
94	34	46		-0.41	
	33			-0.44	66
93	32			-0.47	65
	31	45		-0.50	
92	30			-0.52	64
	29			-0.55	63
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	62
	22			-0.77	
88	21	42		-0.81	61
	20			-0.84	
87	19			-0.88	60
86	18	41		-0.92	
	17			-0.95	59
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	58
	11			-1.23	57
81	10	37		-1.28	55-56
80	9		6	-1.34	
79	8	36		-1.41	54
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	53
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	52
68-70	2	28-30	4	-2.05	50-51
61-67	1	24-27	3	-2.33	47-49
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<47

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 34) included female and male, Afrikaans- and English-speaking, coloured participants with 5 to 7 years of education.

Table 69. *SCWT Word Page Normative Conversion Table: for 13- to 14-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	>113
133-139	99	73-76	17	2.33	113
130-132	98	70-72	16	2.05	112
128-129	97	69		1.88	
126-127	96	67-68		1.75	111
124-125	95	66	15	1.65	110
123	94			1.56	109
122	93	65		1.48	108
121	92	64		1.41	107
120	91		14	1.34	106
119	90	63		1.28	105
	89			1.23	
118	88	62		1.18	104
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	103
	83			0.95	
114	82	59		0.92	102
113	81			0.88	101
	80			0.84	
112	79	58		0.81	
	78			0.77	100
111	77			0.74	99
	76	57		0.71	97-98
110	75		12	0.67	96
	74			0.64	95
109	73	56		0.61	94
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	93
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	92
	64			0.36	91
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	90
102	55			0.13	89
	54	51		0.10	88
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	87
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	86
	43			-0.18	85
97	42	48		-0.20	84
	41			-0.23	83
	40			-0.25	82
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	81
	31	45		-0.50	
92	30			-0.52	80
	29			-0.55	79
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	78
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	77
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	76
	15			-1.04	
84	14	39		-1.08	75
83	13			-1.13	74
82	12	38		-1.18	73
	11			-1.23	72
81	10	37		-1.28	
80	9		6	-1.34	71
79	8	36		-1.41	70
78	7	35		-1.48	69
77	6			-1.56	65-68
75-76	5	34	5	-1.65	61-64
73-74	4	32-33		-1.75	58-60
71-72	3	31		-1.88	55-57
68-70	2	28-30	4	-2.05	54
61-67	1	24-27	3	-2.33	53
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<53

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 44) included female and male, Afrikaans- and English-speaking, coloured and white participants with 6 to 9 years of education.

Table 70. *SCWT Word Page Normative Conversion Table: for 13- to 14-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	>100
133-139	99	73-76	17	2.33	100
130-132	98	70-72	16	2.05	99
128-129	97	69		1.88	98
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	97
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	95-96
120	91		14	1.34	93-94
119	90	63		1.28	91-92
	89			1.23	90
118	88	62		1.18	89
117	87			1.13	
116	86	61		1.08	88
	85			1.04	87
115	84	60	13	0.99	86
	83			0.95	85
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	84
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	83
	74			0.64	
109	73	56		0.61	82
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	81
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	80
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	79
103	58	52		0.20	
	57			0.18	
	56			0.15	78
102	55			0.13	77
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	76
99	47			-0.08	75
	46	49		-0.10	74
98	45			-0.13	
	44			-0.15	
	43			-0.18	73
97	42	48		-0.20	
	41			-0.23	72
	40			-0.25	
96	39			-0.28	71
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	70
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	69
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	68
	22			-0.77	67
88	21	42		-0.81	66
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	65
85	16	40	7	-0.99	
	15			-1.04	64
84	14	39		-1.08	
83	13			-1.13	63
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	62
78	7	35		-1.48	61
77	6			-1.56	59-60
75-76	5	34	5	-1.65	56-58
73-74	4	32-33		-1.75	53-55
71-72	3	31		-1.88	48
68-70	2	28-30	4	-2.05	43-47
61-67	1	24-27	3	-2.33	41-42
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<41

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 51) included female and male, Afrikaans- and English-speaking, coloured participants with 6 to 9 years of education.

Table 71. *SCWT Word Page Normative Conversion Table: for 15-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77- ≥80	18 - ≥19	> 2.67	>120
133-139	99	73-76	17	2.33	120
130-132	98	70-72	16	2.05	119
128-129	97	69		1.88	118
126-127	96	67-68		1.75	117
124-125	95	66	15	1.65	116
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	115
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	114
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	113
114	82	59		0.92	111-112
113	81			0.88	110
	80			0.84	109
112	79	58		0.81	108
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	107
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	106
108	70			0.52	
	69	55		0.50	105
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	104
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	103
	59			0.23	
103	58	52		0.20	
	57			0.18	102
	56			0.15	
102	55			0.13	101
	54	51		0.10	
101	53			0.08	100
	52			0.05	
	51			0.03	99
100	50	50	10	0	98

Std	%ile	T	SS	z	Raw
100	50	50	10	0	98
	49			-0.03	
	48			-0.05	97
99	47			-0.08	96
	46	49		-0.10	95
98	45			-0.13	
	44			-0.15	94
	43			-0.18	93
97	42	48		-0.20	
	41			-0.23	92
	40			-0.25	91
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	90
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	89
93	32			-0.47	88
	31	45		-0.50	
92	30			-0.52	87
	29			-0.55	86
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	85
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	84
	20			-0.84	
87	19			-0.88	83
86	18	41		-0.92	
	17			-0.95	82
85	16	40	7	-0.99	
	15			-1.04	81
84	14	39		-1.08	80
83	13			-1.13	79
82	12	38		-1.18	78
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	77
73-74	4	32-33		-1.75	76
71-72	3	31		-1.88	75
68-70	2	28-30	4	-2.05	74
61-67	1	24-27	3	-2.33	73
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<73

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 19) included female and male, Afrikaans- and English-speaking, coloured and white participants with 8 to 10 years of education.

Table 72. *SCWT Word Page Normative Conversion Table: for 15-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	>107
133-139	99	73-76	17	2.33	107
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	106
126-127	96	67-68		1.75	105
124-125	95	66	15	1.65	104
123	94			1.56	
122	93	65		1.48	103
121	92	64		1.41	102
120	91		14	1.34	101
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	100
115	84	60	13	0.99	
	83			0.95	99
114	82	59		0.92	98
113	81			0.88	97
	80			0.84	96
112	79	58		0.81	95
	78			0.77	
111	77			0.74	
	76	57		0.71	94
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	93
108	70			0.52	92
	69	55		0.50	91
107	68			0.47	
	67			0.44	90
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	89
	62	53		0.31	
104	61			0.28	
	60			0.25	88
	59			0.23	87
103	58	52		0.20	86
	57			0.18	85
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	84
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	83
	48			-0.05	
99	47			-0.08	82
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	81
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	80
95	37		9	-0.33	79
	36			-0.36	
	35			-0.39	78
94	34	46		-0.41	77
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	76
	29			-0.55	
	28			-0.58	75
91	27	44		-0.61	74
	26			-0.64	73
90	25		8	-0.67	72
	24	43		-0.71	
89	23			-0.74	71
	22			-0.77	
88	21	42		-0.81	70
	20			-0.84	69
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	68
	15			-1.04	67
84	14	39		-1.08	
83	13			-1.13	66
82	12	38		-1.18	65
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	64
79	8	36		-1.41	60-63
78	7	35		-1.48	59
77	6			-1.56	
75-76	5	34	5	-1.65	58
73-74	4	32-33		-1.75	57
71-72	3	31		-1.88	52-56
68-70	2	28-30	4	-2.05	45-51
61-67	1	24-27	3	-2.33	44
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<44

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 36) included female and male, Afrikaans- and English-speaking, coloured participants with 8 to 10 years of education.

Table 73. *SCWT Color Page Normative Conversion Table: for 12-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77- ≥80	18 - ≥19	> 2.67	>88
133-139	99	73-76	17	2.33	88
130-132	98	70-72	16	2.05	84-87
128-129	97	69		1.88	81-83
126-127	96	67-68		1.75	77-80
124-125	95	66	15	1.65	75-76
123	94			1.56	74
122	93	65		1.48	73
121	92	64		1.41	72
120	91		14	1.34	
119	90	63		1.28	71
	89			1.23	70
118	88	62		1.18	69
117	87			1.13	68
116	86	61		1.08	
	85			1.04	67
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	66
113	81			0.88	
	80			0.84	
112	79	58		0.81	65
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	64
	64			0.36	
105	63		11	0.33	63
	62	53		0.31	
104	61			0.28	
	60			0.25	62
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	61
	52			0.05	60
	51			0.03	59
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	58
97	42	48		-0.20	57
	41			-0.23	56
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	55
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	54
	29			-0.55	
	28			-0.58	53
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	52
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	51
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	50
75-76	5	34	5	-1.65	49
73-74	4	32-33		-1.75	48
71-72	3	31		-1.88	47
68-70	2	28-30	4	-2.05	44-46
61-67	1	24-27	3	-2.33	42-43
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<42

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 31) included female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 7 years of education.

Table 74. *SCWT Color Page Normative Conversion Table: for 12-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	>74
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	72-74
128-129	97	69		1.88	69-71
126-127	96	67-68		1.75	67-68
124-125	95	66	15	1.65	65-66
123	94			1.56	63-64
122	93	65		1.48	
121	92	64		1.41	62
120	91		14	1.34	
119	90	63		1.28	61
	89			1.23	
118	88	62		1.18	60
117	87			1.13	59
116	86	61		1.08	58
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	57
	80			0.84	
112	79	58		0.81	
	78			0.77	56
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	55
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	54
	59			0.23	53
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	52
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	51
100	50	50	10	0	51
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	50
95	37		9	-0.33	
	36			-0.36	49
	35			-0.39	48
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	47
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	46
87	19			-0.88	
86	18	41		-0.92	45
	17			-0.95	44
85	16	40	7	-0.99	43
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	42
81	10	37		-1.28	
80	9		6	-1.34	41
79	8	36		-1.41	
78	7	35		-1.48	40
77	6			-1.56	
75-76	5	34	5	-1.65	39
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	38
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	37
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<37

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 34) included female and male, Afrikaans- and English-speaking, coloured participants with 5 to 7 years of education.

Table 75. *SCWT Color Page Normative Conversion Table: for 13- to 14-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	>90
133-139	99	73-76	17	2.33	90
130-132	98	70-72	16	2.05	89
128-129	97	69		1.88	86-88
126-127	96	67-68		1.75	83-85
124-125	95	66	15	1.65	80-82
123	94			1.56	78-79
122	93	65		1.48	
121	92	64		1.41	77
120	91		14	1.34	
119	90	63		1.28	76
	89			1.23	
118	88	62		1.18	75
117	87			1.13	
116	86	61		1.08	74
	85			1.04	73
115	84	60	13	0.99	72
	83			0.95	71
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	70
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	69
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	68
107	68			0.47	
	67			0.44	67
106	66	54		0.41	
	65			0.39	
	64			0.36	66
105	63		11	0.33	
	62	53		0.31	65
104	61			0.28	
	60			0.25	64
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	63
	54	51		0.10	
101	53			0.08	62
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	61
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	60
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	59
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	58
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	57
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	56
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	55
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	54
85	16	40	7	-0.99	53
	15			-1.04	52
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	51
	11			-1.23	
81	10	37		-1.28	50
80	9		6	-1.34	49
79	8	36		-1.41	48
78	7	35		-1.48	47
77	6			-1.56	46
75-76	5	34	5	-1.65	45
73-74	4	32-33		-1.75	44
71-72	3	31		-1.88	43
68-70	2	28-30	4	-2.05	42
61-67	1	24-27	3	-2.33	40-41
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<40

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 44) included female and male, Afrikaans- and English-speaking, coloured and white participants with 6 to 9 years of education.

Table 76. *SCWT Color Page Normative Conversion Table: for 13- to 14-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	>74
133-139	99	73-76	17	2.33	74
130-132	98	70-72	16	2.05	73
128-129	97	69		1.88	72
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	71
123	94			1.56	70
122	93	65		1.48	69
121	92	64		1.41	68
120	91		14	1.34	67
119	90	63		1.28	66
	89			1.23	65
118	88	62		1.18	
117	87			1.13	64
116	86	61		1.08	
	85			1.04	63
115	84	60	13	0.99	
	83			0.95	62
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	61
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	60
109	73	56		0.61	59
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	58
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	57
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	56
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	55
98	45			-0.13	54
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	53
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	52
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	51
92	30			-0.52	
	29			-0.55	50
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	49
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	48
85	16	40	7	-0.99	
	15			-1.04	47
84	14	39		-1.08	
83	13			-1.13	46
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	45
78	7	35		-1.48	44
77	6			-1.56	
75-76	5	34	5	-1.65	43
73-74	4	32-33		-1.75	42
71-72	3	31		-1.88	41
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	40
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<40

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 51) included female and male, Afrikaans- and English-speaking, coloured participants with 6 to 9 years of education.

Table 77. *SCWT Color Page Normative Conversion Table: for 15-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77- ≥80	18 - ≥19	> 2.67	>85
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	85
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	84
117	87			1.13	83
116	86	61		1.08	
	85			1.04	82
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	81
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	80
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	79
	65			0.39	
	64			0.36	
105	63		11	0.33	78
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	77
	54	51		0.10	
101	53			0.08	
	52			0.05	76
	51			0.03	
100	50	50	10	0	75

Std	%ile	T	SS	z	Raw
100	50	50	10	0	75
	49			-0.03	74
	48			-0.05	73
99	47			-0.08	72
	46	49		-0.10	
98	45			-0.13	71
	44			-0.15	70
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	69
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	68
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	67
	33			-0.44	66
93	32			-0.47	65
	31	45		-0.50	64
92	30			-0.52	63
	29			-0.55	62
	28			-0.58	61
91	27	44		-0.61	60
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	59
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	58
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	57
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	56
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	55
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	54
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	53
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<53

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 19) included female and male, Afrikaans- and English-speaking, coloured and white participants with 8 to 10 years of education.

Table 78. *SCWT Color Page Normative Conversion Table: for 15-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	>98
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	98
126-127	96	67-68		1.75	93-97
124-125	95	66	15	1.65	79-92
123	94			1.56	
122	93	65		1.48	73-78
121	92	64		1.41	72
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	71
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	70
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	69
110	75		12	0.67	
	74			0.64	68
109	73	56		0.61	
	72			0.58	67
	71			0.55	
108	70			0.52	
	69	55		0.50	66
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	65
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	64
	57			0.18	
	56			0.15	63
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	62
	43			-0.18	61
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	60
92	30			-0.52	59
	29			-0.55	
	28			-0.58	58
91	27	44		-0.61	57
	26			-0.64	56
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	55
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	54
87	19			-0.88	
86	18	41		-0.92	53
	17			-0.95	52
85	16	40	7	-0.99	51
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	50
82	12	38		-1.18	48-49
	11			-1.23	45-47
81	10	37		-1.28	44
80	9		6	-1.34	43
79	8	36		-1.41	42
78	7	35		-1.48	
77	6			-1.56	41
75-76	5	34	5	-1.65	40
73-74	4	32-33		-1.75	39
71-72	3	31		-1.88	37-38
68-70	2	28-30	4	-2.05	35-36
61-67	1	24-27	3	-2.33	34
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<34

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 36) included female and male, Afrikaans- and English-speaking, coloured participants with 8 to 10 years of education.

Table 79. *SCWT Color-Word Page Normative Conversion Table: for 12-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	>57
133-139	99	73-76	17	2.33	57
130-132	98	70-72	16	2.05	55-56
128-129	97	69		1.88	54
126-127	96	67-68		1.75	52-53
124-125	95	66	15	1.65	49-51
123	94			1.56	48
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	47
	89			1.23	
118	88	62		1.18	46
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	45
114	82	59		0.92	
113	81			0.88	44
	80			0.84	43
112	79	58		0.81	
	78			0.77	42
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	41
	71			0.55	
108	70			0.52	
	69	55		0.50	40
107	68			0.47	
	67			0.44	
106	66	54		0.41	39
	65			0.39	38
	64			0.36	
105	63		11	0.33	
	62	53		0.31	37
104	61			0.28	
	60			0.25	
	59			0.23	36
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	35
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	34
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	33
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	32
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	31
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	30
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	29
85	16	40	7	-0.99	28
	15			-1.04	26-27
84	14	39		-1.08	24-25
83	13			-1.13	23
82	12	38		-1.18	
	11			-1.23	22
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	21
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	20
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<20

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 31) included female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 7 years of education.

Table 80. *SCWT Color-Word Page Normative Conversion Table: for 12-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 -≥19	> 2.67	>57
133-139	99	73-76	17	2.33	57
130-132	98	70-72	16	2.05	55-56
128-129	97	69		1.88	54
126-127	96	67-68		1.75	51-53
124-125	95	66	15	1.65	49-50
123	94			1.56	48
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	47
	89			1.23	
118	88	62		1.18	46
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	45
114	82	59		0.92	
113	81			0.88	44
	80			0.84	43
112	79	58		0.81	
	78			0.77	42
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	41
	71			0.55	
108	70			0.52	
	69	55		0.50	40
107	68			0.47	
	67			0.44	
106	66	54		0.41	39
	65			0.39	38
	64			0.36	
105	63		11	0.33	
	62	53		0.31	37
104	61			0.28	
	60			0.25	
	59			0.23	36
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	35
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	34
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	33
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	32
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	31
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	30
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	29
85	16	40	7	-0.99	28
	15			-1.04	26-27
84	14	39		-1.08	24-25
83	13			-1.13	23
82	12	38		-1.18	
	11			-1.23	22
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	21
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	20
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<20

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 34) included female and male, Afrikaans- and English-speaking, coloured participants with 5 to 7 years of education.

Table 81. *SCWT Color-Word Page Normative Conversion Table: for 13-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	>52
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	52
128-129	97	69		1.88	
126-127	96	67-68		1.75	51
124-125	95	66	15	1.65	
123	94			1.56	50
122	93	65		1.48	49
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	48
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	47
114	82	59		0.92	
113	81			0.88	46
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	45
109	73	56		0.61	
	72			0.58	
	71			0.55	44
108	70			0.52	
	69	55		0.50	43
107	68			0.47	
	67			0.44	
106	66	54		0.41	42
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	41
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	40
	57			0.18	39
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	38
98	45			-0.13	
	44			-0.15	
	43			-0.18	37
97	42	48		-0.20	
	41			-0.23	36
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	35
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	34
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	33
89	23			-0.74	32
	22			-0.77	31
88	21	42		-0.81	30
	20			-0.84	
87	19			-0.88	29
86	18	41		-0.92	
	17			-0.95	28
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	27
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	26
78	7	35		-1.48	
77	6			-1.56	25
75-76	5	34	5	-1.65	24
73-74	4	32-33		-1.75	23
71-72	3	31		-1.88	22
68-70	2	28-30	4	-2.05	20-21
61-67	1	24-27	3	-2.33	19
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<19

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 26) included female and male, Afrikaans- and English-speaking, coloured and white participants with 6 to 8 years of education.

Table 82. *SCWT Color-Word Page Normative Conversion Table: for 13-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77- ≥80	18 - ≥19	> 2.67	>39
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	39
128-129	97	69		1.88	38
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	37
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	36
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	35
	74			0.64	
109	73	56		0.61	34
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	33
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	32
103	58	52		0.20	
	57			0.18	31
	56			0.15	30
102	55			0.13	
	54	51		0.10	29
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	28
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	27
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	26
	28			-0.58	25
91	27	44		-0.61	
	26			-0.64	24
90	25		8	-0.67	23
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	22
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	21
	11			-1.23	
81	10	37		-1.28	20
80	9		6	-1.34	19
79	8	36		-1.41	
78	7	35		-1.48	18
77	6			-1.56	17
75-76	5	34	5	-1.65	16
73-74	4	32-33		-1.75	15
71-72	3	31		-1.88	14
68-70	2	28-30	4	-2.05	12-13
61-67	1	24-27	3	-2.33	11
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<11

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 18) included female and male, Afrikaans- and English-speaking, coloured participants with 6 to 8 years of education.

Table 83. *SCWT Color-Word Page Normative Conversion Table: for 14-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 -≥19	> 2.67	>71
133-139	99	73-76	17	2.33	71
130-132	98	70-72	16	2.05	70
128-129	97	69		1.88	
126-127	96	67-68		1.75	69
124-125	95	66	15	1.65	68
123	94			1.56	67
122	93	65		1.48	64-66
121	92	64		1.41	62-63
120	91		14	1.34	60-61
119	90	63		1.28	57-59
	89			1.23	55-56
118	88	62		1.18	53-54
117	87			1.13	52
116	86	61		1.08	50-51
	85			1.04	49
115	84	60	13	0.99	48
	83			0.95	47
114	82	59		0.92	
113	81			0.88	46
	80			0.84	
112	79	58		0.81	
	78			0.77	45
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	44
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	43
105	63		11	0.33	42
	62	53		0.31	41
104	61			0.28	
	60			0.25	40
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	39
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	38

Std	%ile	T	SS	z	Raw
100	50	50	10	0	38
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	37
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	36
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	35
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	34
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	33
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	32
	17			-0.95	31
85	16	40	7	-0.99	30
	15			-1.04	29
84	14	39		-1.08	28
83	13			-1.13	27
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	26
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	25
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<25

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 18) included female and male, Afrikaans- and English-speaking, coloured and white participants with 7 to 9 years of education.

Table 84. *SCWT Color-Word Page Normative Conversion Table: for 14-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	>47
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	47
128-129	97	69		1.88	
126-127	96	67-68		1.75	46
124-125	95	66	15	1.65	45
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	44
120	91		14	1.34	
119	90	63		1.28	43
	89			1.23	
118	88	62		1.18	42
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	41
114	82	59		0.92	
113	81			0.88	
	80			0.84	40
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	39
	72			0.58	
	71			0.55	
108	70			0.52	38
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	37
105	63		11	0.33	36
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	35
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	34
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	33
	38	47		-0.31	32
95	37		9	-0.33	31
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	30
	24	43		-0.71	29
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	28
86	18	41		-0.92	26-27
	17			-0.95	25
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	24
82	12	38		-1.18	
	11			-1.23	23
81	10	37		-1.28	
80	9		6	-1.34	22
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	21
75-76	5	34	5	-1.65	20
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	19
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	18
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<18

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 32) included female and male, Afrikaans- and English-speaking, coloured participants with 7 to 9 years of education.

Table 85. *SCWT Color-Word Page Normative Conversion Table: for 15-year-old participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	>62
133-139	99	73-76	17	2.33	62
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	61
124-125	95	66	15	1.65	
123	94			1.56	60
122	93	65		1.48	59
121	92	64		1.41	
120	91		14	1.34	58
119	90	63		1.28	57
	89			1.23	
118	88	62		1.18	56
117	87			1.13	55
116	86	61		1.08	
	85			1.04	54
115	84	60	13	0.99	
	83			0.95	53
114	82	59		0.92	52
113	81			0.88	51
	80			0.84	50
112	79	58		0.81	49
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	48
	74			0.64	
109	73	56		0.61	
	72			0.58	47
	71			0.55	
108	70			0.52	46
	69	55		0.50	
107	68			0.47	45
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	44
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	43
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	42
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	41
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	40
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	39
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	38
	15			-1.04	
84	14	39		-1.08	37
83	13			-1.13	36
82	12	38		-1.18	
	11			-1.23	35
81	10	37		-1.28	34
80	9		6	-1.34	33
79	8	36		-1.41	32
78	7	35		-1.48	31
77	6			-1.56	30
75-76	5	34	5	-1.65	29
73-74	4	32-33		-1.75	28
71-72	3	31		-1.88	27
68-70	2	28-30	4	-2.05	26
61-67	1	24-27	3	-2.33	25
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<25

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 19) included female and male, Afrikaans- and English-speaking, coloured and white participants with 8 to 10 years of education.

Table 86. *SCWT Color-Word Page Normative Conversion Table: for 15-year-old participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	>54
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	54
126-127	96	67-68		1.75	53
124-125	95	66	15	1.65	51-52
123	94			1.56	50
122	93	65		1.48	48-49
121	92	64		1.41	46-47
120	91		14	1.34	
119	90	63		1.28	45
	89			1.23	
118	88	62		1.18	44
117	87			1.13	
116	86	61		1.08	43
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	42
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	41
107	68			0.47	
	67			0.44	40
106	66	54		0.41	
	65			0.39	
	64			0.36	39
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	38
	60			0.25	
	59			0.23	37
103	58	52		0.20	
	57			0.18	
	56			0.15	36
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	35
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	34
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	33
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	32
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	31
	20			-0.84	30
87	19			-0.88	
86	18	41		-0.92	29
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	28
84	14	39		-1.08	27
83	13			-1.13	26
82	12	38		-1.18	25
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	24
78	7	35		-1.48	22-23
77	6			-1.56	21
75-76	5	34	5	-1.65	20
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	19
61-67	1	24-27	3	-2.33	18
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<18

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 37) included female and male, Afrikaans- and English-speaking, coloured participants with 8 to 10 years of education.

Table 87. *ToL Total Correct Normative Conversion Table: for the whole sample*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	10
133-139	99	73-76	17	2.33	9
130-132	98	70-72	16	2.05	8
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	7
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	6
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	5
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	4
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	3
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	2
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	1
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 215) included 12- to 15-year old, female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 10 years of advantaged and disadvantaged quality of education.

Table 88. *ToL Total Time Normative Conversion Table: for 12-year-old participants*

Std	%ile	T	SS	z	Raw	Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	<128	100	50	50	10	0	240
							49			-0.03	
133-139	99	73-76	17	2.33	128		48			-0.05	241
130-132	98	70-72	16	2.05	137	99	47			-0.08	242
128-129	97	69		1.88	142		46	49		-0.10	243
126-127	96	67-68		1.75	144	98	45			-0.13	245
124-125	95	66	15	1.65	145		44			-0.15	246
123	94			1.56	148		43			-0.18	250
122	93	65		1.48	149	97	42	48		-0.20	
121	92	64		1.41	150		41			-0.23	255
120	91		14	1.34	152		40			-0.25	
119	90	63		1.28	154	96	39			-0.28	256
	89			1.23	156		38	47		-0.31	260
118	88	62		1.18	160	95	37		9	-0.33	261
117	87			1.13	162		36			-0.36	262
116	86	61		1.08	163		35			-0.39	263
	85			1.04	165	94	34	46		-0.41	265
115	84	60	13	0.99	168		33			-0.44	269
	83			0.95	172	93	32			-0.47	271
114	82	59		0.92	173		31	45		-0.50	
113	81			0.88	174	92	30			-0.52	272
	80			0.84	176		29			-0.55	274
112	79	58		0.81	178		28			-0.58	277
	78			0.77		91	27	44		-0.61	278
111	77			0.74	180		26			-0.64	279
	76	57		0.71	181	90	25		8	-0.67	282
110	75		12	0.67	185		24	43		-0.71	289
	74			0.64	186	89	23			-0.74	
109	73	56		0.61	189		22			-0.77	
	72			0.58	197	88	21	42		-0.81	294
	71			0.55	199		20			-0.84	297
108	70			0.52		87	19			-0.88	304
	69	55		0.50	200	86	18	41		-0.92	320
107	68			0.47	202		17			-0.95	336
	67			0.44	204	85	16	40	7	-0.99	337
106	66	54		0.41	206		15			-1.04	340
	65			0.39	208	84	14	39		-1.08	345
	64			0.36	209	83	13			-1.13	346
105	63		11	0.33	213	82	12	38		-1.18	349
	62	53		0.31			11			-1.23	352
104	61			0.28	215	81	10	37		-1.28	356
	60			0.25	216	80	9		6	-1.34	363
	59			0.23	218	79	8	36		-1.41	374
103	58	52		0.20	219	78	7	35		-1.48	380
	57			0.18	223	77	6			-1.56	395
	56			0.15		75-76	5	34	5	-1.65	443
102	55			0.13	226	73-74	4	32-33		-1.75	469
	54	51		0.10	230	71-72	3	31		-1.88	483
101	53			0.08	234	68-70	2	28-30	4	-2.05	486
	52			0.05	235	61-67	1	24-27	3	-2.33	490
	51			0.03	237	≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>490
100	50	50	10	0	240						

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 65) included female and male, Afrikaans- and English-speaking, coloured and white participants with 5 to 7 years of advantaged and disadvantaged quality of education.

Table 89. *ToL Total Time Normative Conversion Table: for 13- to 15-year-old participants*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	<109
133-139	99	73-76	17	2.33	109
130-132	98	70-72	16	2.05	114
128-129	97	69		1.88	120
126-127	96	67-68		1.75	121
124-125	95	66	15	1.65	125
123	94			1.56	129
122	93	65		1.48	131
121	92	64		1.41	132
120	91		14	1.34	
119	90	63		1.28	133
	89			1.23	138
118	88	62		1.18	140
117	87			1.13	
116	86	61		1.08	142
	85			1.04	145
115	84	60	13	0.99	147
	83			0.95	
114	82	59		0.92	148
113	81			0.88	149
	80			0.84	150
112	79	58		0.81	151
	78			0.77	155
111	77			0.74	156
	76	57		0.71	158
110	75		12	0.67	160
	74			0.64	161
109	73	56		0.61	164
	72			0.58	166
	71			0.55	167
108	70			0.52	169
	69	55		0.50	171
107	68			0.47	174
	67			0.44	175
106	66	54		0.41	177
	65			0.39	178
	64			0.36	179
105	63		11	0.33	180
	62	53		0.31	
104	61			0.28	181
	60			0.25	
	59			0.23	182
103	58	52		0.20	184
	57			0.18	185
	56			0.15	188
102	55			0.13	189
	54	51		0.10	191
101	53			0.08	192
	52			0.05	194
	51			0.03	196
100	50	50	10	0	197

Std	%ile	T	SS	z	Raw
100	50	50	10	0	197
	49			-0.03	198
	48			-0.05	200
99	47			-0.08	201
	46	49		-0.10	202
98	45			-0.13	204
	44			-0.15	208
	43			-0.18	210
97	42	48		-0.20	213
	41			-0.23	216
	40			-0.25	217
96	39			-0.28	219
	38	47		-0.31	
95	37		9	-0.33	220
	36			-0.36	
	35			-0.39	221
94	34	46		-0.41	
	33			-0.44	226
93	32			-0.47	229
	31	45		-0.50	232
92	30			-0.52	235
	29			-0.55	241
	28			-0.58	244
91	27	44		-0.61	246
	26			-0.64	249
90	25		8	-0.67	252
	24	43		-0.71	253
89	23			-0.74	254
	22			-0.77	255
88	21	42		-0.81	261
	20			-0.84	267
87	19			-0.88	269
86	18	41		-0.92	274
	17			-0.95	276
85	16	40	7	-0.99	279
	15			-1.04	287
84	14	39		-1.08	291
83	13			-1.13	294
82	12	38		-1.18	297
	11			-1.23	299
81	10	37		-1.28	302
80	9		6	-1.34	314
79	8	36		-1.41	320
78	7	35		-1.48	
77	6			-1.56	326
75-76	5	34	5	-1.65	331
73-74	4	32-33		-1.75	337
71-72	3	31		-1.88	346
68-70	2	28-30	4	-2.05	384
61-67	1	24-27	3	-2.33	418
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	>418

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 150) included female and male, Afrikaans- and English-speaking, coloured and white participants with 6 to 10 years of advantaged and disadvantaged quality of education.

Table 90. *Phonemic Fluency Normative Conversion Table: for 12-year-old, Afrikaans-speaking participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	>45
133-139	99	73-76	17	2.33	45
130-132	98	70-72	16	2.05	44
128-129	97	69		1.88	43
126-127	96	67-68		1.75	42
124-125	95	66	15	1.65	41
123	94			1.56	40
122	93	65		1.48	39
121	92	64		1.41	38
120	91		14	1.34	37
119	90	63		1.28	36
	89			1.23	35
118	88	62		1.18	34
117	87			1.13	33
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	32
	41			-0.23	
	40			-0.25	31
96	39			-0.28	
	38	47		-0.31	30
95	37		9	-0.33	
	36			-0.36	29
	35			-0.39	
94	34	46		-0.41	28
	33			-0.44	
93	32			-0.47	27
	31	45		-0.50	
92	30			-0.52	26
	29			-0.55	
	28			-0.58	25
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	24
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	23
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	22
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	21
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	20
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-19

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 8) included female and male, coloured and white participants with 5 to 7 years of education.

Table 91. *Phonemic Fluency Normative Conversion Table: for 12-year-old, Afrikaans-speaking participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	>37
133-139	99	73-76	17	2.33	37
130-132	98	70-72	16	2.05	36
128-129	97	69		1.88	
126-127	96	67-68		1.75	35
124-125	95	66	15	1.65	
123	94			1.56	34
122	93	65		1.48	
121	92	64		1.41	33
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	32
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	31
113	81			0.88	30
	80			0.84	
112	79	58		0.81	
	78			0.77	29
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	28
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	27
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	26
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	25
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	24
	40			-0.25	
96	39			-0.28	23
	38	47		-0.31	22
95	37		9	-0.33	21
	36			-0.36	20
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	19
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	18
87	19			-0.88	17
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	16
82	12	38		-1.18	15
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	14
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	13
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	12
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-11

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 30) included female and male, coloured participants with 5 to 7 years of education.

Table 92. *Phonemic Fluency Normative Conversion Table: for 12-year-old, English-speaking participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77- ≥80	18 - ≥19	> 2.67	>48
133-139	99	73-76	17	2.33	48
130-132	98	70-72	16	2.05	47
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	45
121	92	64		1.41	
120	91		14	1.34	44
119	90	63		1.28	43
	89			1.23	
118	88	62		1.18	42
117	87			1.13	
116	86	61		1.08	41
	85			1.04	40
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	39
112	79	58		0.81	38
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	37
107	68			0.47	36
	67			0.44	
106	66	54		0.41	35
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	34
	57			0.18	33
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	32
	52			0.05	
	51			0.03	31
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	30
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	29
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	28
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	27
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	26
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	25
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	24
	24	43		-0.71	
89	23			-0.74	23
	22			-0.77	
88	21	42		-0.81	22
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	21
80	9		6	-1.34	
79	8	36		-1.41	20
78	7	35		-1.48	18
77	6			-1.56	17
75-76	5	34	5	-1.65	16
73-74	4	32-33		-1.75	15
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	14
61-67	1	24-27	3	-2.33	13
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-12

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 37) included female and male, coloured and white participants with 5 to 7 years of education.

Table 93. *Phonemic Fluency Normative Conversion Table: for 12-year-old, English-speaking participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	>39
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	39
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	38
122	93	65		1.48	37
121	92	64		1.41	35
120	91		14	1.34	34
119	90	63		1.28	33
	89			1.23	32
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	31
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	30
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	29
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	28
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	27
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	26

Std	%ile	T	SS	z	Raw
100	50	50	10	0	26
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	25
98	45			-0.13	
	44			-0.15	
	43			-0.18	24
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	23
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	22
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	21
	24	43		-0.71	
89	23			-0.74	20
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	19
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	18
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	17
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	16
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	15
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-14

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 18) included female and male, coloured participants with 5 to 7 years of education.

Table 94. *Phonemic Fluency Normative Conversion Table: for 13- to 14-year-old, Afrikaans-speaking participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	>39
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	39
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	38
122	93	65		1.48	37
121	92	64		1.41	35
120	91		14	1.34	34
119	90	63		1.28	33
	89			1.23	32
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	31
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	30
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	29
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	28
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	27
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	26

Std	%ile	T	SS	z	Raw
100	50	50	10	0	26
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	25
98	45			-0.13	
	44			-0.15	
	43			-0.18	24
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	23
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	22
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	21
	24	43		-0.71	
89	23			-0.74	20
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	19
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	18
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	17
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	16
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	15
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-14

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 20) included female and male, coloured and white participants with 6 to 9 years of education.

Table 95. *Phonemic Fluency Normative Conversion Table: for 13- to 14-year-old, Afrikaans-speaking participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw	Std	%ile	T	SS	z	Raw
140-≥145	>99	77- ≥80	18 - ≥19	> 2.67	>41	100	50	50	10	0	
							49			-0.03	
133-139	99	73-76	17	2.33	41		48			-0.05	
130-132	98	70-72	16	2.05	40	99	47			-0.08	
128-129	97	69		1.88			46	49		-0.10	
126-127	96	67-68		1.75	38	98	45			-0.13	
124-125	95	66	15	1.65			44			-0.15	27
123	94			1.56			43			-0.18	
122	93	65		1.48	37	97	42	48		-0.20	
121	92	64		1.41	36		41			-0.23	
120	91		14	1.34			40			-0.25	
119	90	63		1.28		96	39			-0.28	
	89			1.23			38	47		-0.31	26
118	88	62		1.18		95	37		9	-0.33	
117	87			1.13			36			-0.36	
116	86	61		1.08	35		35			-0.39	
	85			1.04		94	34	46		-0.41	
115	84	60	13	0.99			33			-0.44	
	83			0.95	34	93	32			-0.47	25
114	82	59		0.92			31	45		-0.50	23
113	81			0.88		92	30			-0.52	22
	80			0.84	33		29			-0.55	
112	79	58		0.81			28			-0.58	
	78			0.77		91	27	44		-0.61	
111	77			0.74			26			-0.64	
	76	57		0.71		90	25		8	-0.67	
110	75		12	0.67			24	43		-0.71	
	74			0.64		89	23			-0.74	
109	73	56		0.61			22			-0.77	
	72			0.58		88	21	42		-0.81	21
	71			0.55			20			-0.84	
108	70			0.52	32	87	19			-0.88	
	69	55		0.50		86	18	41		-0.92	
107	68			0.47			17			-0.95	
	67			0.44	31	85	16	40	7	-0.99	20
106	66	54		0.41			15			-1.04	
	65			0.39		84	14	39		-1.08	19
	64			0.36	30	83	13			-1.13	
105	63		11	0.33	29	82	12	38		-1.18	18
	62	53		0.31			11			-1.23	
104	61			0.28		81	10	37		-1.28	
	60			0.25	28	80	9		6	-1.34	17
	59			0.23		79	8	36		-1.41	
103	58	52		0.20		78	7	35		-1.48	
	57			0.18		77	6			-1.56	
	56			0.15		75-76	5	34	5	-1.65	16
102	55			0.13		73-74	4	32-33		-1.75	
	54	51		0.10		71-72	3	31		-1.88	15
101	53			0.08		68-70	2	28-30	4	-2.05	13
	52			0.05		61-67	1	24-27	3	-2.33	12
	51			0.03		≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-11
100	50	50	10	0							

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 32) included female and male, coloured participants with 6 to 9 years of education.

Table 96. *Phonemic Fluency Normative Conversion Table: for 13- to 14-year-old, English-speaking participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	>46
133-139	99	73-76	17	2.33	46
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	45
126-127	96	67-68		1.75	44
124-125	95	66	15	1.65	
123	94			1.56	43
122	93	65		1.48	
121	92	64		1.41	42
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	41
118	88	62		1.18	
117	87			1.13	40
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	39
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	38
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	37
107	68			0.47	
	67			0.44	36
106	66	54		0.41	
	65			0.39	35
	64			0.36	34
105	63		11	0.33	33
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	32
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	31
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	30
	38	47		-0.31	
95	37		9	-0.33	29
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	28
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	27
88	21	42		-0.81	26
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	25
85	16	40	7	-0.99	
	15			-1.04	24
84	14	39		-1.08	23
83	13			-1.13	22
82	12	38		-1.18	21
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	20
79	8	36		-1.41	
78	7	35		-1.48	19
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	18
61-67	1	24-27	3	-2.33	17
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-16

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 41) included female and male, coloured and white participants with 6 to 9 years of education.

Table 97. *Phonemic Fluency Normative Conversion Table: for 13- to 14-year-old, English-speaking participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	>46
133-139	99	73-76	17	2.33	46
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	45
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	44
123	94			1.56	43
122	93	65		1.48	
121	92	64		1.41	42
120	91		14	1.34	
119	90	63		1.28	41
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	40
	83			0.95	
114	82	59		0.92	
113	81			0.88	39
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	38
	71			0.55	37
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	36
	65			0.39	
	64			0.36	
105	63		11	0.33	35
	62	53		0.31	
104	61			0.28	
	60			0.25	34
	59			0.23	33
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	32
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	31
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	30
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	29
	26			-0.64	
90	25		8	-0.67	28
	24	43		-0.71	
89	23			-0.74	27
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	26
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	25
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	24
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	23
78	7	35		-1.48	
77	6			-1.56	22
75-76	5	34	5	-1.65	21
73-74	4	32-33		-1.75	20
71-72	3	31		-1.88	19
68-70	2	28-30	4	-2.05	18
61-67	1	24-27	3	-2.33	16
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-15

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 34) included female and male, coloured participants with 6 to 9 years of education.

Table 98. *Phonemic Fluency Normative Conversion Table: for 15-year-old, Afrikaans-speaking participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77- ≥80	18 - ≥19	> 2.67	
133-139	99	73-76	17	2.33	50
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	49
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	48
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	47
	89			1.23	
118	88	62		1.18	46
117	87			1.13	
116	86	61		1.08	
	85			1.04	45
115	84	60	13	0.99	44
	83			0.95	
114	82	59		0.92	43
113	81			0.88	42
	80			0.84	
112	79	58		0.81	41
	78			0.77	
111	77			0.74	40
	76	57		0.71	39
110	75		12	0.67	
	74			0.64	38
109	73	56		0.61	37
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	36
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	35
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	34
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	33
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	32
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	31
92	30			-0.52	
	29			-0.55	
	28			-0.58	30
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	29
	24	43		-0.71	
89	23			-0.74	28
	22			-0.77	
88	21	42		-0.81	27
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	26
	17			-0.95	
85	16	40	7	-0.99	25
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	24
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	23
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	22
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-21

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 8) included female and male, coloured and white participants with 8 to 10 years of education.

Table 99. *Phonemic Fluency Normative Conversion Table: for 15-year-old, Afrikaans-speaking participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	>42
133-139	99	73-76	17	2.33	42
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	41
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	40
120	91		14	1.34	
119	90	63		1.28	39
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	38
112	79	58		0.81	
	78			0.77	37
111	77			0.74	
	76	57		0.71	36
110	75		12	0.67	35
	74			0.64	
109	73	56		0.61	34
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	33
107	68			0.47	
	67			0.44	
106	66	54		0.41	32
	65			0.39	
	64			0.36	31
105	63		11	0.33	
	62	53		0.31	30
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	29
	54	51		0.10	
101	53			0.08	28
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	27
	36			-0.36	26
	35			-0.39	25
94	34	46		-0.41	
	33			-0.44	24
93	32			-0.47	
	31	45		-0.50	23
92	30			-0.52	
	29			-0.55	
	28			-0.58	22
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	21
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	20
81	10	37		-1.28	19
80	9		6	-1.34	18
79	8	36		-1.41	
78	7	35		-1.48	17
77	6			-1.56	
75-76	5	34	5	-1.65	16
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	15
61-67	1	24-27	3	-2.33	14
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-13

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 28) included female and male, coloured participants with 8 to 10 years of education.

Table 100. *Phonemic Fluency Normative Conversion Table: for 15-year-old, English-speaking participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	>83
133-139	99	73-76	17	2.33	83
130-132	98	70-72	16	2.05	77
128-129	97	69		1.88	70
126-127	96	67-68		1.75	63
124-125	95	66	15	1.65	57
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	53
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	52
117	87			1.13	
116	86	61		1.08	
	85			1.04	51
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	50
106	66	54		0.41	49
	65			0.39	48
	64			0.36	47
105	63		11	0.33	45
	62	53		0.31	44
104	61			0.28	
	60			0.25	
	59			0.23	43
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	42
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	41
	43			-0.18	
97	42	48		-0.20	40
	41			-0.23	
	40			-0.25	39
96	39			-0.28	38
	38	47		-0.31	37
95	37		9	-0.33	36
	36			-0.36	
	35			-0.39	35
94	34	46		-0.41	34
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	33
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	32
	20			-0.84	
87	19			-0.88	31
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	30
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	29
81	10	37		-1.28	28
80	9		6	-1.34	27
79	8	36		-1.41	26
78	7	35		-1.48	25
77	6			-1.56	24
75-76	5	34	5	-1.65	23
73-74	4	32-33		-1.75	22
71-72	3	31		-1.88	21
68-70	2	28-30	4	-2.05	20
61-67	1	24-27	3	-2.33	18
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-17

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 19) included female and male, coloured and white participants with 8 to 10 years of education.

Table 101. *Phonemic Fluency Normative Conversion Table: for 15-year-old, English-speaking participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	>48
133-139	99	73-76	17	2.33	48
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	47
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	46
123	94			1.56	
122	93	65		1.48	45
121	92	64		1.41	
120	91		14	1.34	44
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	43
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	42
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	41
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	40
	72			0.58	
	71			0.55	
108	70			0.52	39
	69	55		0.50	
107	68			0.47	38
	67			0.44	37
106	66	54		0.41	
	65			0.39	36
	64			0.36	35
105	63		11	0.33	34
	62	53		0.31	
104	61			0.28	33
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	32
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	31
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	30
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	29
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	28
86	18	41		-0.92	
	17			-0.95	27
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	26
83	13			-1.13	
82	12	38		-1.18	25
	11			-1.23	
81	10	37		-1.28	24
80	9		6	-1.34	
79	8	36		-1.41	23
78	7	35		-1.48	22
77	6			-1.56	
75-76	5	34	5	-1.65	21
73-74	4	32-33		-1.75	20
71-72	3	31		-1.88	19
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	18
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-17

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 11) included female and male, coloured participants with 8 to 10 years of education.

Table 102. *Semantic Fluency Normative Conversion Table: for 12-year-old, coloured participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	>29
133-139	99	73-76	17	2.33	29
130-132	98	70-72	16	2.05	28
128-129	97	69		1.88	26
126-127	96	67-68		1.75	25
124-125	95	66	15	1.65	24
123	94			1.56	23
122	93	65		1.48	22
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	21
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	20
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	19
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	18
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	17
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	16
	52			0.05	
	51			0.03	
100	50	50	10	0	15
100	50	50	10	0	15
	49			-0.03	
	48			-0.05	14
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	13
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	12
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	11
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	10
61-67	1	24-27	3	-2.33	9
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<9

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 14) included female and male, Afrikaans- and English-speaking participants with 5 to 7 years of education.

Table 103. *Semantic Fluency Normative Conversion Table: for 12-year-old, coloured participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77- ≥80	18 - ≥19	> 2.67	>20
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	20
123	94			1.56	
122	93	65		1.48	19
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	18
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	17
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	16
111	77			0.74	
	76	57		0.71	15
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	14
	52			0.05	13
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	12
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	11
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	10
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	9
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	8
61-67	1	24-27	3	-2.33	7
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<7

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 48) included female and male, Afrikaans- and English-speaking participants with 5 to 7 years of education.

Table 104. *Semantic Fluency Normative Conversion Table: for 12-year-old, white participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	>27
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	27
126-127	96	67-68		1.75	26
124-125	95	66	15	1.65	25
123	94			1.56	24
122	93	65		1.48	23
121	92	64		1.41	22
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	21
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	20
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	19
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	18
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	17
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	16
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	15
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	14
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	13
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	12
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	11
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	10
75-76	5	34	5	-1.65	9
73-74	4	32-33		-1.75	8
71-72	3	31		-1.88	7
68-70	2	28-30	4	-2.05	5
61-67	1	24-27	3	-2.33	2
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<2

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 31) included female and male, Afrikaans- and English-speaking participants with 5 to 7 years of education.

Table 105. *Semantic Fluency Normative Conversion Table: for 13- to 15-year-old, coloured participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	>25
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	25
128-129	97	69		1.88	24
126-127	96	67-68		1.75	23
124-125	95	66	15	1.65	
123	94			1.56	21
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	20
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	19
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	18
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	17
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	16
	26			-0.64	
90	25		8	-0.67	15
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	14
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	13
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	12
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	11
61-67	1	24-27	3	-2.33	10
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<10

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 40) included female and male, Afrikaans- and English-speaking participants with 6 to 10 years of education.

Table 106. *Semantic Fluency Normative Conversion Table: for 13- to 15-year-old, coloured participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	>25
133-139	99	73-76	17	2.33	25
130-132	98	70-72	16	2.05	23
128-129	97	69		1.88	22
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	21
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	20
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	19
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	18
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	17
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	16
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	15
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	14
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	13
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	12
83	13			-1.13	11
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	10
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	9
71-72	3	31		-1.88	8
68-70	2	28-30	4	-2.05	7
61-67	1	24-27	3	-2.33	6
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<6

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 105) included female and male, Afrikaans- and English-speaking participants with 6 to 10 years of education.

Table 107. *Semantic Fluency Normative Conversion Table: for 13- to 15-year-old, white participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	>37
133-139	99	73-76	17	2.33	37
130-132	98	70-72	16	2.05	30
128-129	97	69		1.88	
126-127	96	67-68		1.75	29
124-125	95	66	15	1.65	28
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	27
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	26
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	25
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	24
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	23
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	22
103	58	52		0.20	
	57			0.18	21
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	20
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	19
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	18
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	17
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	16
81	10	37		-1.28	15
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	14
73-74	4	32-33		-1.75	13
71-72	3	31		-1.88	10
68-70	2	28-30	4	-2.05	7
61-67	1	24-27	3	-2.33	3
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	<3

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 48) included female and male, Afrikaans- and English-speaking participants with 6 to 10 years of education.

Table 108. *WASI Block Design Normative Conversion Table: for 12-year-old, coloured participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	56-71
133-139	99	73-76	17	2.33	55
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	54
126-127	96	67-68		1.75	53
124-125	95	66	15	1.65	52
123	94			1.56	
122	93	65		1.48	51
121	92	64		1.41	50
120	91		14	1.34	48
119	90	63		1.28	47
	89			1.23	46
118	88	62		1.18	45
117	87			1.13	44
116	86	61		1.08	43
	85			1.04	
115	84	60	13	0.99	41
	83			0.95	40
114	82	59		0.92	
113	81			0.88	39
	80			0.84	38
112	79	58		0.81	
	78			0.77	37
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	36
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	35
	67			0.44	
106	66	54		0.41	34
	65			0.39	
	64			0.36	
105	63		11	0.33	33
	62	53		0.31	
104	61			0.28	
	60			0.25	32
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	31
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	30
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	29
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	28
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	27
94	34	46		-0.41	
	33			-0.44	26
93	32			-0.47	
	31	45		-0.50	25
92	30			-0.52	24
	29			-0.55	22
	28			-0.58	21
91	27	44		-0.61	19
	26			-0.64	18
90	25		8	-0.67	16
	24	43		-0.71	14
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	13
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	12
84	14	39		-1.08	
83	13			-1.13	11
82	12	38		-1.18	
	11			-1.23	10
81	10	37		-1.28	
80	9		6	-1.34	9
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	8
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	7
61-67	1	24-27	3	-2.33	6
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-5

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 14) included female and male, Afrikaans- and English-speaking participants with 5 to 7 years of education.

Table 109. *WASI Block Design Normative Conversion Table: for 12-year-old, coloured participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	44-71
133-139	99	73-76	17	2.33	43
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	42
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	41
123	94			1.56	40
122	93	65		1.48	38
121	92	64		1.41	34
120	91		14	1.34	32
119	90	63		1.28	
	89			1.23	31
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	30
115	84	60	13	0.99	29
	83			0.95	28
114	82	59		0.92	27
113	81			0.88	
	80			0.84	25
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	24
109	73	56		0.61	23
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	22
	67			0.44	
106	66	54		0.41	
	65			0.39	21
	64			0.36	
105	63		11	0.33	
	62	53		0.31	20
104	61			0.28	19
	60			0.25	18
	59			0.23	17
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	16
100	50	50	10	0	16
	49			-0.03	
	48			-0.05	15
99	47			-0.08	
	46	49		-0.10	14
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	13
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	12
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	11
	22			-0.77	
88	21	42		-0.81	10
	20			-0.84	9
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	8
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	7
61-67	1	24-27	3	-2.33	6
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-5

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 48) included female and male, Afrikaans- and English-speaking participants with 5 to 7 years of education.

Table 110. *WASI Block Design Normative Conversion Table: for 12-year-old, white participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	56-71
133-139	99	73-76	17	2.33	55
130-132	98	70-72	16	2.05	54
128-129	97	69		1.88	
126-127	96	67-68		1.75	53
124-125	95	66	15	1.65	52
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	51
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	50
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	49
112	79	58		0.81	48
	78			0.77	47
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	45
	72			0.58	
	71			0.55	44
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	43
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	42
	54	51		0.10	
101	53			0.08	41
	52			0.05	
	51			0.03	40
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	39
98	45			-0.13	38
	44			-0.15	
	43			-0.18	37
97	42	48		-0.20	
	41			-0.23	36
	40			-0.25	
96	39			-0.28	35
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	34
94	34	46		-0.41	
	33			-0.44	33
93	32			-0.47	
	31	45		-0.50	32
92	30			-0.52	31
	29			-0.55	
	28			-0.58	30
91	27	44		-0.61	29
	26			-0.64	28
90	25		8	-0.67	27
	24	43		-0.71	26
89	23			-0.74	
	22			-0.77	25
88	21	42		-0.81	
	20			-0.84	24
87	19			-0.88	
86	18	41		-0.92	23
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	22
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	21
	11			-1.23	
81	10	37		-1.28	20
80	9		6	-1.34	19
79	8	36		-1.41	18
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	16
68-70	2	28-30	4	-2.05	14
61-67	1	24-27	3	-2.33	13
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-12

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 31) included female and male, Afrikaans- and English-speaking participants with 5 to 7 years of education.

Table 111. *WASI Block Design Normative Conversion Table: for 13- to 15-year-old, coloured participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw	Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	63-71	100	50	50	10	0	30
133-139	99	73-76	17	2.33	62		49			-0.03	
130-132	98	70-72	16	2.05	59		48			-0.05	29
128-129	97	69		1.88	58	99	47			-0.08	
126-127	96	67-68		1.75			46	49		-0.10	
124-125	95	66	15	1.65		98	45			-0.13	28
123	94			1.56	57		44			-0.15	
122	93	65		1.48	56		43			-0.18	27
121	92	64		1.41	55	97	42	48		-0.20	
120	91		14	1.34	52		41			-0.23	
119	90	63		1.28	50		40			-0.25	26
	89			1.23	48	96	39			-0.28	
118	88	62		1.18	47		38	47		-0.31	
117	87			1.13	46	95	37		9	-0.33	
116	86	61		1.08	45		36			-0.36	25
	85			1.04			35			-0.39	
115	84	60	13	0.99		94	34	46		-0.41	
	83			0.95			33			-0.44	
114	82	59		0.92	44	93	32			-0.47	
113	81			0.88	43		31	45		-0.50	
	80			0.84		92	30			-0.52	
112	79	58		0.81	42		29			-0.55	
	78			0.77			28			-0.58	
111	77			0.74		91	27	44		-0.61	24
	76	57		0.71	41		26			-0.64	
110	75		12	0.67		90	25		8	-0.67	23
	74			0.64	40		24	43		-0.71	22
109	73	56		0.61		89	23			-0.74	21
	72			0.58			22			-0.77	19
	71			0.55	39	88	21	42		-0.81	17
108	70			0.52			20			-0.84	
	69	55		0.50		87	19			-0.88	
107	68			0.47	38	86	18	41		-0.92	
	67			0.44			17			-0.95	
106	66	54		0.41		85	16	40	7	-0.99	16
	65			0.39			15			-1.04	15
	64			0.36	37	84	14	39		-1.08	13
105	63		11	0.33	35	83	13			-1.13	10
	62	53		0.31	33	82	12	38		-1.18	
104	61			0.28			11			-1.23	9
	60			0.25		81	10	37		-1.28	
	59			0.23		80	9		6	-1.34	
103	58	52		0.20	32	79	8	36		-1.41	
	57			0.18		78	7	35		-1.48	8
	56			0.15		77	6			-1.56	
102	55			0.13		75-76	5	34	5	-1.65	
	54	51		0.10		73-74	4	32-33		-1.75	7
101	53			0.08	31	71-72	3	31		-1.88	
	52			0.05		68-70	2	28-30	4	-2.05	
	51			0.03		61-67	1	24-27	3	-2.33	6
100	50	50	10	0	30	≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-5

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 40) included female and male, Afrikaans- and English-speaking participants with 6 to 10 years of education.

Table 112. *WASI Block Design Normative Conversion Table: for 13- to 15-year-old, coloured participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	53-71
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	52
128-129	97	69		1.88	50
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	49
123	94			1.56	48
122	93	65		1.48	47
121	92	64		1.41	46
120	91		14	1.34	45
119	90	63		1.28	
	89			1.23	44
118	88	62		1.18	43
117	87			1.13	
116	86	61		1.08	42
	85			1.04	
115	84	60	13	0.99	41
	83			0.95	40
114	82	59		0.92	39
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	37
111	77			0.74	36
	76	57		0.71	
110	75		12	0.67	
	74			0.64	35
109	73	56		0.61	
	72			0.58	
	71			0.55	34
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	33
	65			0.39	
	64			0.36	
105	63		11	0.33	32
	62	53		0.31	
104	61			0.28	30
	60			0.25	
	59			0.23	29
103	58	52		0.20	
	57			0.18	28
	56			0.15	26
102	55			0.13	25
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	24
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	23
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	22
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	21
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	20
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	19
90	25		8	-0.67	18
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	17
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	16
	15			-1.04	15
84	14	39		-1.08	14
83	13			-1.13	13
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	12
79	8	36		-1.41	11
78	7	35		-1.48	
77	6			-1.56	10
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	8
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-7

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 105) included female and male, Afrikaans- and English-speaking participants with 6 to 10 years of education.

Table 113. *WASI Block Design Normative Conversion Table: for 13- to 15-year-old, white participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	65-71
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	64
128-129	97	69		1.88	63
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	61
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	60
118	88	62		1.18	59
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	58
113	81			0.88	
	80			0.84	
112	79	58		0.81	57
	78			0.77	56
111	77			0.74	55
	76	57		0.71	54
110	75		12	0.67	
	74			0.64	53
109	73	56		0.61	
	72			0.58	52
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	51
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	50
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	49
103	58	52		0.20	
	57			0.18	48
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	47
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	46
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	45
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	44
	33			-0.44	43
93	32			-0.47	
	31	45		-0.50	41
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	40
	24	43		-0.71	39
89	23			-0.74	38
	22			-0.77	
88	21	42		-0.81	37
	20			-0.84	
87	19			-0.88	36
86	18	41		-0.92	34
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	33
83	13			-1.13	32
82	12	38		-1.18	31
	11			-1.23	
81	10	37		-1.28	30
80	9		6	-1.34	29
79	8	36		-1.41	28
78	7	35		-1.48	25
77	6			-1.56	23
75-76	5	34	5	-1.65	22
73-74	4	32-33		-1.75	20
71-72	3	31		-1.88	16
68-70	2	28-30	4	-2.05	12
61-67	1	24-27	3	-2.33	10
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-9

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 48) included female and male, Afrikaans- and English-speaking participants with 6 to 10 years of education.

Table 114. *WASI Matrix Reasoning Normative Conversion Table: for Afrikaans-speaking, coloured participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw	Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	29-35	100	50	50	10	0	
							49			-0.03	
133-139	99	73-76	17	2.33			48			-0.05	
130-132	98	70-72	16	2.05	28	99	47			-0.08	
128-129	97	69		1.88	27		46	49		-0.10	
126-127	96	67-68		1.75	26	98	45			-0.13	
124-125	95	66	15	1.65			44			-0.15	16
123	94			1.56	25		43			-0.18	
122	93	65		1.48		97	42	48		-0.20	
121	92	64		1.41			41			-0.23	
120	91		14	1.34			40			-0.25	
119	90	63		1.28		96	39			-0.28	
	89			1.23			38	47		-0.31	
118	88	62		1.18		95	37		9	-0.33	15
117	87			1.13			36			-0.36	
116	86	61		1.08			35			-0.39	
	85			1.04		94	34	46		-0.41	
115	84	60	13	0.99	24		33			-0.44	
	83			0.95		93	32			-0.47	
114	82	59		0.92			31	45		-0.50	
113	81			0.88		92	30			-0.52	14
	80			0.84			29			-0.55	
112	79	58		0.81			28			-0.58	
	78			0.77		91	27	44		-0.61	
111	77			0.74			26			-0.64	13
	76	57		0.71		90	25		8	-0.67	
110	75		12	0.67			24	43		-0.71	12
	74			0.64		89	23			-0.74	
109	73	56		0.61	23		22			-0.77	11
	72			0.58		88	21	42		-0.81	
	71			0.55			20			-0.84	
108	70			0.52	22	87	19			-0.88	
	69	55		0.50		86	18	41		-0.92	
107	68			0.47	21		17			-0.95	10
	67			0.44		85	16	40	7	-0.99	
106	66	54		0.41	20		15			-1.04	
	65			0.39	19	84	14	39		-1.08	
	64			0.36		83	13			-1.13	
105	63		11	0.33	18	82	12	38		-1.18	
	62	53		0.31			11			-1.23	
104	61			0.28	17	81	10	37		-1.28	9
	60			0.25		80	9		6	-1.34	
	59			0.23		79	8	36		-1.41	
103	58	52		0.20		78	7	35		-1.48	
	57			0.18		77	6			-1.56	
	56			0.15		75-76	5	34	5	-1.65	
102	55			0.13		73-74	4	32-33		-1.75	8
	54	51		0.10		71-72	3	31		-1.88	
101	53			0.08		68-70	2	28-30	4	-2.05	
	52			0.05		61-67	1	24-27	3	-2.33	7
	51			0.03		≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-6
100	50	50	10	0							

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 16) included 12- to 15-year old, female and male participants with 5 to 10 years of education.

Table 115. *WASI Matrix Reasoning Normative Conversion Table: for Afrikaans-speaking, coloured participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	27-35
133-139	99	73-76	17	2.33	26
130-132	98	70-72	16	2.05	25
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	24
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	23
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	22
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	21
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	20
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	19
101	53			0.08	
	52			0.05	18
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	17
	44			-0.15	
	43			-0.18	16
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	15
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	14
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	13
	24	43		-0.71	12
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	11
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	10
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	9
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	8
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	7
61-67	1	24-27	3	-2.33	6
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-5

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 90) included 12- to 15-year old, female and male participants with 5 to 10 years of education.

Table 116. *WASI Matrix Reasoning Normative Conversion Table: for Afrikaans-speaking, white participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	31-35
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	30
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	29
113	81			0.88	
	80			0.84	
112	79	58		0.81	28
	78			0.77	
111	77			0.74	27
	76	57		0.71	
110	75		12	0.67	26
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	25
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	24
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	23
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	22
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	21
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	20
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	19
80	9		6	-1.34	18
79	8	36		-1.41	17
78	7	35		-1.48	16
77	6			-1.56	15
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	14
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-13

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 20) included 12- to 15-year old, female and male participants with 5 to 10 years of education.

Table 117. *WASI Matrix Reasoning Normative Conversion Table: for English-speaking, coloured participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	30-35
133-139	99	73-76	17	2.33	29
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	28
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	27
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	26
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	25
	69	55		0.50	24
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	23

Std	%ile	T	SS	z	Raw
100	50	50	10	0	23
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	22
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	21
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	20
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	19
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	18
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	17
	15			-1.04	16
84	14	39		-1.08	
83	13			-1.13	15
82	12	38		-1.18	
	11			-1.23	14
81	10	37		-1.28	
80	9		6	-1.34	13
79	8	36		-1.41	
78	7	35		-1.48	12
77	6			-1.56	
75-76	5	34	5	-1.65	11
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	10
68-70	2	28-30	4	-2.05	9
61-67	1	24-27	3	-2.33	7
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-6

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 38) included 12- to 15-year old, female and male participants with 5 to 10 years of education.

Table 118. *WASI Matrix Reasoning Normative Conversion Table: for English-speaking, coloured participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	30-35
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	29
128-129	97	69		1.88	
126-127	96	67-68		1.75	28
124-125	95	66	15	1.65	27
123	94			1.56	26
122	93	65		1.48	25
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	24
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	23
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	22
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	21
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	20
97	42	48		-0.20	19
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	18
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	17
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	16
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	15
86	18	41		-0.92	13
	17			-0.95	12
85	16	40	7	-0.99	11
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	10
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	9
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	8
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-7

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 63) included 12- to 15-year old, female and male participants with 5 to 10 years of education.

Table 119. *WASI Matrix Reasoning Normative Conversion Table: for English-speaking, white participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw	Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	33-35	100	50	50	10	0	
133-139	99	73-76	17	2.33			49			-0.03	
130-132	98	70-72	16	2.05			48			-0.05	
128-129	97	69		1.88		99	47			-0.08	
126-127	96	67-68		1.75			46	49		-0.10	
124-125	95	66	15	1.65		98	45			-0.13	
123	94			1.56	32		44			-0.15	26
122	93	65		1.48			43			-0.18	
121	92	64		1.41		97	42	48		-0.20	
120	91		14	1.34			41			-0.23	
119	90	63		1.28			40			-0.25	
	89			1.23	31	96	39			-0.28	
118	88	62		1.18			38	47		-0.31	
117	87			1.13		95	37		9	-0.33	
116	86	61		1.08			36			-0.36	25
	85			1.04			35			-0.39	
115	84	60	13	0.99		94	34	46		-0.41	
	83			0.95			33			-0.44	
114	82	59		0.92		93	32			-0.47	
113	81			0.88			31	45		-0.50	
	80			0.84		92	30			-0.52	
112	79	58		0.81			29			-0.55	24
	78			0.77			28			-0.58	
111	77			0.74	30	91	27	44		-0.61	
	76	57		0.71			26			-0.64	
110	75		12	0.67		90	25		8	-0.67	
	74			0.64			24	43		-0.71	23
109	73	56		0.61		89	23			-0.74	
	72			0.58	29		22			-0.77	22
	71			0.55		88	21	42		-0.81	
108	70			0.52			20			-0.84	
	69	55		0.50		87	19			-0.88	
107	68			0.47		86	18	41		-0.92	
	67			0.44	28		17			-0.95	21
106	66	54		0.41		85	16	40	7	-0.99	
	65			0.39			15			-1.04	20
	64			0.36		84	14	39		-1.08	
105	63		11	0.33		83	13			-1.13	19
	62	53		0.31		82	12	38		-1.18	
104	61			0.28			11			-1.23	
	60			0.25		81	10	37		-1.28	18
	59			0.23		80	9		6	-1.34	
103	58	52		0.20		79	8	36		-1.41	
	57			0.18		78	7	35		-1.48	16
	56			0.15		77	6			-1.56	
102	55			0.13		75-76	5	34	5	-1.65	15
	54	51		0.10		73-74	4	32-33		-1.75	14
101	53			0.08		71-72	3	31		-1.88	13
	52			0.05		68-70	2	28-30	4	-2.05	
	51			0.03	27	61-67	1	24-27	3	-2.33	11
100	50	50	10	0		≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-10

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 59) included 12- to 15-year old, female and male participants with 5 to 10 years of education.

Table 120. *WASI Similarities Normative Conversion Table: for Afrikaans-speaking, coloured participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	37-48
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	36
128-129	97	69		1.88	35
126-127	96	67-68		1.75	34
124-125	95	66	15	1.65	
123	94			1.56	33
122	93	65		1.48	
121	92	64		1.41	32
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	31
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	30
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	29
	71			0.55	
108	70			0.52	
	69	55		0.50	28
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	27
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	26
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	25
100	50	50	10	0	25
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	24
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	23
90	25		8	-0.67	
	24	43		-0.71	22
89	23			-0.74	
	22			-0.77	21
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	20
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	19
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	18
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	17
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	16
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	15
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-14

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 16) included 12- to 15-year-old, female and male participants with 5 to 10 years of education.

Table 121. *WASI Similarities Normative Conversion Table: for Afrikaans-speaking, coloured participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	33-35
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	32
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	31
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	30
120	91		14	1.34	
119	90	63		1.28	29
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	28
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	27
	78			0.77	
111	77			0.74	26
	76	57		0.71	
110	75		12	0.67	
	74			0.64	25
109	73	56		0.61	24
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	23
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	22
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	21
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	20
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	19
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	18
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	17
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	16
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	15
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	14
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	13
77	6			-1.56	12
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	11
68-70	2	28-30	4	-2.05	10
61-67	1	24-27	3	-2.33	8
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-7

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 90) included 12- to 15-year-old, female and male participants with 5 to 10 years of education.

Table 122. *WASI Similarities Normative Conversion Table: for Afrikaans-speaking, white participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	43-48
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	42
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	41
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	40
118	88	62		1.18	
117	87			1.13	39
116	86	61		1.08	38
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	37
	78			0.77	
111	77			0.74	36
	76	57		0.71	35
110	75		12	0.67	34
	74			0.64	
109	73	56		0.61	
	72			0.58	33
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	32
	67			0.44	
106	66	54		0.41	31
	65			0.39	30
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	29
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	28
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	27
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	26
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-25

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 20) included 12- to 15-year-old, female and male participants with 5 to 10 years of education.

Table 123. *WASI Similarities Normative Conversion Table: for English-speaking, coloured participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	38-48
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	37
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	36
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	35
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	34
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	33
	69	55		0.50	32
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	31
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	30
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	29
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	28
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	27
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	26
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	25
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	24
82	12	38		-1.18	23
	11			-1.23	
81	10	37		-1.28	22
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	21
75-76	5	34	5	-1.65	20
73-74	4	32-33		-1.75	19
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	17
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-16

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 38) included 12- to 15-year-old, female and male participants with 5 to 10 years of education.

Table 124. *WASI Similarities Normative Conversion Table: for English-speaking, coloured participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 -≥19	> 2.67	43-48
133-139	99	73-76	17	2.33	42
130-132	98	70-72	16	2.05	39
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	37
123	94			1.56	
122	93	65		1.48	36
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	35
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	34
113	81			0.88	
	80			0.84	
112	79	58		0.81	33
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	32
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	31
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	30
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	29

Std	%ile	T	SS	z	Raw
100	50	50	10	0	29
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	28
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	27
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	26
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	25
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	24
88	21	42		-0.81	23
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	22
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	21
83	13			-1.13	20
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	19
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	18
75-76	5	34	5	-1.65	17
73-74	4	32-33		-1.75	16
71-72	3	31		-1.88	14
68-70	2	28-30	4	-2.05	10
61-67	1	24-27	3	-2.33	7
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-6

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 63) included 12- to 15-year-old, female and male participants with 5 to 10 years of education.

Table 125. *WASI Similarities Normative Conversion Table: for English-speaking, white participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	
133-139	99	73-76	17	2.33	48
130-132	98	70-72	16	2.05	47
128-129	97	69		1.88	45
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	44
122	93	65		1.48	43
121	92	64		1.41	42
120	91		14	1.34	41
119	90	63		1.28	40
	89			1.23	
118	88	62		1.18	39
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	38
	76	57		0.71	
110	75		12	0.67	
	74			0.64	37
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	36
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	35
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	34
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	33
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	32
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	31
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	30
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	29
87	19			-0.88	28
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	27
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	26
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	25
71-72	3	31		-1.88	22
68-70	2	28-30	4	-2.05	14
61-67	1	24-27	3	-2.33	11
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-10

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 59) included 12- to 15-year-old, female and male participants with 5 to 10 years of education.

Table 126. *WASI Vocabulary Normative Conversion Table: for 12-year-old, Afrikaans-speaking, coloured participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	53-72
133-139	99	73-76	17	2.33	52
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	51
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	50
123	94			1.56	
122	93	65		1.48	49
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	48
	89			1.23	
118	88	62		1.18	47
117	87			1.13	
116	86	61		1.08	46
	85			1.04	
115	84	60	13	0.99	45
	83			0.95	
114	82	59		0.92	
113	81			0.88	44
	80			0.84	
112	79	58		0.81	43
	78			0.77	
111	77			0.74	42
	76	57		0.71	
110	75		12	0.67	
	74			0.64	41
109	73	56		0.61	
	72			0.58	40
	71			0.55	
108	70			0.52	39
	69	55		0.50	
107	68			0.47	38
	67			0.44	
106	66	54		0.41	
	65			0.39	37
	64			0.36	
105	63		11	0.33	36
	62	53		0.31	
104	61			0.28	35
	60			0.25	
	59			0.23	
103	58	52		0.20	34
	57			0.18	33
	56			0.15	
102	55			0.13	
	54	51		0.10	32
101	53			0.08	
	52			0.05	31
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	30
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-29

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 3) included female and male participants with 5 to 7 years of education.

Table 127. *WASI Vocabulary Normative Conversion Table: for 12-year-old, Afrikaans-speaking, coloured participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	45-72
133-139	99	73-76	17	2.33	44
130-132	98	70-72	16	2.05	42
128-129	97	69		1.88	39
126-127	96	67-68		1.75	38
124-125	95	66	15	1.65	
123	94			1.56	37
122	93	65		1.48	36
121	92	64		1.41	35
120	91		14	1.34	34
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	33
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	32
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	31
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	30
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	29

Std	%ile	T	SS	z	Raw
100	50	50	10	0	29
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	28
	40			-0.25	
96	39			-0.28	27
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	26
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	25
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	24
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	23
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	22
77	6			-1.56	
75-76	5	34	5	-1.65	21
73-74	4	32-33		-1.75	20
71-72	3	31		-1.88	19
68-70	2	28-30	4	-2.05	17
61-67	1	24-27	3	-2.33	15
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-14

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 30) included female and male participants with 5 to 7 years of education.

Table 128. *WASI Vocabulary Normative Conversion Table: for 12-year-old, Afrikaans-speaking, white participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	56-72
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	55
128-129	97	69		1.88	
126-127	96	67-68		1.75	54
124-125	95	66	15	1.65	
123	94			1.56	53
122	93	65		1.48	
121	92	64		1.41	52
120	91		14	1.34	
119	90	63		1.28	51
	89			1.23	
118	88	62		1.18	50
117	87			1.13	
116	86	61		1.08	49
	85			1.04	48
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	47
113	81			0.88	
	80			0.84	46
112	79	58		0.81	
	78			0.77	45
111	77			0.74	
	76	57		0.71	44
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	43
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	42
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	41
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	40
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	39
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	38
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	37
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	36
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	35
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	34
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	33
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	32
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-31

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 5) included female and male participants with 5 to 7 years of education.

Table 129. *WASI Vocabulary Normative Conversion Table: for 12-year-old, English-speaking, coloured participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	61-72
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	60
128-129	97	69		1.88	
126-127	96	67-68		1.75	59
124-125	95	66	15	1.65	58
123	94			1.56	
122	93	65		1.48	57
121	92	64		1.41	
120	91		14	1.34	56
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	55
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	54
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	53
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	52
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	51

Std	%ile	T	SS	z	Raw
100	50	50	10	0	51
	49			-0.03	
	48			-0.05	50
99	47			-0.08	
	46	49		-0.10	49
98	45			-0.13	48
	44			-0.15	
	43			-0.18	47
97	42	48		-0.20	
	41			-0.23	46
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	45
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	44
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	43
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	42
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	41
80	9		6	-1.34	40
79	8	36		-1.41	
78	7	35		-1.48	39
77	6			-1.56	38
75-76	5	34	5	-1.65	37
73-74	4	32-33		-1.75	36
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	35
61-67	1	24-27	3	-2.33	34
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-33

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 11) included female and male participants with 5 to 7 years of education.

Table 130. *WASI Vocabulary Normative Conversion Table: for 12-year-old, English-speaking, coloured participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 -≥19	> 2.67	47-72
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	46
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	45
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	44
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	43
110	75		12	0.67	
	74			0.64	42
109	73	56		0.61	
	72			0.58	41
	71			0.55	
108	70			0.52	40
	69	55		0.50	
107	68			0.47	
	67			0.44	39
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	38
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	37
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	36
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	35
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	34
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	33
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	32
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	31
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	30
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	29
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	28
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	27
75-76	5	34	5	-1.65	26
73-74	4	32-33		-1.75	24
71-72	3	31		-1.88	23
68-70	2	28-30	4	-2.05	21
61-67	1	24-27	3	-2.33	20
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	1-19

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 18) included female and male participants with 5 to 7 years of education.

Table 131. *WASI Vocabulary Normative Conversion Table: for 12-year-old, English-speaking, white participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	63-72
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	62
128-129	97	69		1.88	61
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	60
123	94			1.56	
122	93	65		1.48	59
121	92	64		1.41	
120	91		14	1.34	58
119	90	63		1.28	
	89			1.23	57
118	88	62		1.18	
117	87			1.13	56
116	86	61		1.08	
	85			1.04	55
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	54
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	53
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	52
	57			0.18	
	56			0.15	
102	55			0.13	51
	54	51		0.10	
101	53			0.08	50
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	46
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	45
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	44
	29			-0.55	
	28			-0.58	43
91	27	44		-0.61	42
	26			-0.64	41
90	25		8	-0.67	40
	24	43		-0.71	39
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	38
84	14	39		-1.08	
83	13			-1.13	37
82	12	38		-1.18	36
	11			-1.23	35
81	10	37		-1.28	34
80	9		6	-1.34	32
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	31
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	30
71-72	3	31		-1.88	28
68-70	2	28-30	4	-2.05	26
61-67	1	24-27	3	-2.33	23
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-22

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 26) included female and male participants with 5 to 7 years of education.

Table 132. *WASI Vocabulary Normative Conversion Table: for 13- to 15-year-old, Afrikaans-speaking, coloured participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	50-72
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	49
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	48
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	47
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	46
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	45
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	44
	74			0.64	
109	73	56		0.61	43
	72			0.58	
	71			0.55	42
108	70			0.52	41
	69	55		0.50	
107	68			0.47	40
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	39
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	38
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	37
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	36
98	45			-0.13	
	44			-0.15	35
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	34
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	33
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	32
	24	43		-0.71	
89	23			-0.74	31
	22			-0.77	
88	21	42		-0.81	30
	20			-0.84	29
87	19			-0.88	
86	18	41		-0.92	28
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	27
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	26
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-25

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 13) included female and male participants with 6 to 10 years of education.

Table 133. *WASI Vocabulary Normative Conversion Table: for 13- to 15-year-old, Afrikaans-speaking, coloured participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	52-72
133-139	99	73-76	17	2.33	51
130-132	98	70-72	16	2.05	50
128-129	97	69		1.88	49
126-127	96	67-68		1.75	48
124-125	95	66	15	1.65	47
123	94			1.56	
122	93	65		1.48	46
121	92	64		1.41	
120	91		14	1.34	45
119	90	63		1.28	44
	89			1.23	43
118	88	62		1.18	
117	87			1.13	42
116	86	61		1.08	41
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	40
	78			0.77	
111	77			0.74	
	76	57		0.71	39
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	38
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	37
107	68			0.47	
	67			0.44	36
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	35
	62	53		0.31	34
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	33
102	55			0.13	
	54	51		0.10	32
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	31
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	30
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	29
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	28
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	27
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	26
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	25
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	24
82	12	38		-1.18	23
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	22
79	8	36		-1.41	21
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	20
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	19
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	18
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-17

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 60) included female and male participants with 6 to 10 years of education.

Table 134. *WASI Vocabulary Normative Conversion Table: for 13- to 15-year-old, Afrikaans-speaking, white participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	67-72
133-139	99	73-76	17	2.33	66
130-132	98	70-72	16	2.05	65
128-129	97	69		1.88	64
126-127	96	67-68		1.75	63
124-125	95	66	15	1.65	62
123	94			1.56	61
122	93	65		1.48	
121	92	64		1.41	60
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	59
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	58
	83			0.95	
114	82	59		0.92	
113	81			0.88	57
	80			0.84	
112	79	58		0.81	
	78			0.77	56
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	55
	74			0.64	
109	73	56		0.61	54
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	53
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	52
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	51
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	50
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	49

Std	%ile	T	SS	z	Raw
100	50	50	10	0	49
	49			-0.03	
	48			-0.05	48
99	47			-0.08	
	46	49		-0.10	47
98	45			-0.13	
	44			-0.15	46
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	45
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	44
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	43
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	42
83	13			-1.13	
82	12	38		-1.18	41
	11			-1.23	
81	10	37		-1.28	40
80	9		6	-1.34	39
79	8	36		-1.41	
78	7	35		-1.48	38
77	6			-1.56	36
75-76	5	34	5	-1.65	34
73-74	4	32-33		-1.75	33
71-72	3	31		-1.88	31
68-70	2	28-30	4	-2.05	29
61-67	1	24-27	3	-2.33	28
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-27

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 15) included female and male participants with 6 to 10 years of education.

Table 135. *WASI Vocabulary Normative Conversion Table: for 13- to 15-year-old, English-speaking, coloured participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	58-72
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	57
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	56
	83			0.95	
114	82	59		0.92	55
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	54
	71			0.55	
108	70			0.52	
	69	55		0.50	53
107	68			0.47	
	67			0.44	52
106	66	54		0.41	
	65			0.39	51
	64			0.36	
105	63		11	0.33	50
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	49
	52			0.05	
	51			0.03	48
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	47
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	46
	24	43		-0.71	
89	23			-0.74	45
	22			-0.77	
88	21	42		-0.81	44
	20			-0.84	
87	19			-0.88	43
86	18	41		-0.92	
	17			-0.95	42
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	41
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	40
81	10	37		-1.28	
80	9		6	-1.34	39
79	8	36		-1.41	38
78	7	35		-1.48	
77	6			-1.56	37
75-76	5	34	5	-1.65	36
73-74	4	32-33		-1.75	35
71-72	3	31		-1.88	33
68-70	2	28-30	4	-2.05	32
61-67	1	24-27	3	-2.33	30
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-29

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 27) included female and male participants with 6 to 10 years of education.

Table 136. *WASI Vocabulary Normative Conversion Table: for 13- to 15-year-old, English-speaking, coloured participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 -≥19	> 2.67	61-72
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	60
128-129	97	69		1.88	59
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	58
119	90	63		1.28	57
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	55
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	54
113	81			0.88	53
	80			0.84	
112	79	58		0.81	
	78			0.77	
111	77			0.74	52
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	51
	69	55		0.50	50
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	49
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	48
102	55			0.13	
	54	51		0.10	47
101	53			0.08	
	52			0.05	46
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	45
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	44
	44			-0.15	
	43			-0.18	43
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	42
	35			-0.39	41
94	34	46		-0.41	
	33			-0.44	40
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	39
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	38
89	23			-0.74	
	22			-0.77	37
88	21	42		-0.81	
	20			-0.84	36
87	19			-0.88	
86	18	41		-0.92	35
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	34
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	
79	8	36		-1.41	33
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	32
73-74	4	32-33		-1.75	30
71-72	3	31		-1.88	27
68-70	2	28-30	4	-2.05	25
61-67	1	24-27	3	-2.33	24
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-23

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 45) included female and male participants with 6 to 10 years of education.

Table 137. *WASI Vocabulary Normative Conversion Table: for 13- to 15-year-old, English-speaking, white participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	71-72
133-139	99	73-76	17	2.33	70
130-132	98	70-72	16	2.05	68
128-129	97	69		1.88	65
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	64
123	94			1.56	63
122	93	65		1.48	62
121	92	64		1.41	61
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	60
114	82	59		0.92	
113	81			0.88	59
	80			0.84	
112	79	58		0.81	58
	78			0.77	
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	57
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	56
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	55
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	54
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	53
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	52
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	51
	33			-0.44	50
93	32			-0.47	49
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	48
91	27	44		-0.61	
	26			-0.64	47
90	25		8	-0.67	46
	24	43		-0.71	45
89	23			-0.74	44
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	43
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	42
84	14	39		-1.08	41
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	40
79	8	36		-1.41	39
78	7	35		-1.48	38
77	6			-1.56	37
75-76	5	34	5	-1.65	
73-74	4	32- 33		-1.75	36
71-72	3	31		-1.88	34
68-70	2	28- 30	4	-2.05	30
61-67	1	24- 27	3	-2.33	25
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-24

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 33) included female and male participants with 6 to 10 years of education.

Table 138. *WISC Coding Normative Conversion Table: for 12- to 13-year-old, female participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	>74
133-139	99	73-76	17	2.33	74
130-132	98	70-72	16	2.05	71
128-129	97	69		1.88	69
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	68
123	94			1.56	
122	93	65		1.48	67
121	92	64		1.41	66
120	91		14	1.34	65
119	90	63		1.28	
	89			1.23	63
118	88	62		1.18	62
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	61
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	60
108	70			0.52	
	69	55		0.50	
107	68			0.47	59
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	58
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	57
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	56
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	55
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	54
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	53
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	52
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	51
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	50
86	18	41		-0.92	
	17			-0.95	49
85	16	40	7	-0.99	46
	15			-1.04	44
84	14	39		-1.08	
83	13			-1.13	42
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	41
79	8	36		-1.41	
78	7	35		-1.48	40
77	6			-1.56	39
75-76	5	34	5	-1.65	38
73-74	4	32-33		-1.75	37
71-72	3	31		-1.88	36
68-70	2	28-30	4	-2.05	35
61-67	1	24-27	3	-2.33	34
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-33

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 30) included Afrikaans- and English-speaking, coloured and white participants with 5 to 8 years of education.

Table 139. *WISC Coding Normative Conversion Table: for 12- to 13-year-old, female participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	>60
133-139	99	73-76	17	2.33	60
130-132	98	70-72	16	2.05	59
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	57
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	
	89			1.23	56
118	88	62		1.18	
117	87			1.13	
116	86	61		1.08	
	85			1.04	55
115	84	60	13	0.99	
	83			0.95	
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	54
	78			0.77	
111	77			0.74	53
	76	57		0.71	
110	75		12	0.67	52
	74			0.64	51
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	50
	65			0.39	49
	64			0.36	
105	63		11	0.33	
	62	53		0.31	48
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	47
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	46
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	45
94	34	46		-0.41	
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	44
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	43
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	42
86	18	41		-0.92	
	17			-0.95	41
85	16	40	7	-0.99	40
	15			-1.04	38
84	14	39		-1.08	36
83	13			-1.13	
82	12	38		-1.18	35
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	34
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	33
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	32
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-31

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (n = 31) included Afrikaans- and English-speaking, coloured participants with 5 to 8 years of education.

Table 140. *WISC Coding Normative Conversion Table: for 12- to 13-year-old, male participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	> 69
133-139	99	73-76	17	2.33	69
130-132	98	70-72	16	2.05	67
128-129	97	69		1.88	66
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	65
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	64
119	90	63		1.28	63
	89			1.23	62
118	88	62		1.18	61
117	87			1.13	60
116	86	61		1.08	59
	85			1.04	58
115	84	60	13	0.99	
	83			0.95	57
114	82	59		0.92	
113	81			0.88	56
	80			0.84	
112	79	58		0.81	55
	78			0.77	54
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	53
	74			0.64	
109	73	56		0.61	
	72			0.58	52
	71			0.55	
108	70			0.52	
	69	55		0.50	
107	68			0.47	
	67			0.44	
106	66	54		0.41	
	65			0.39	
	64			0.36	51
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	50
	59			0.23	
103	58	52		0.20	
	57			0.18	49
	56			0.15	
102	55			0.13	48
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	47
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	46
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	45
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	44
90	25		8	-0.67	43
	24	43		-0.71	
89	23			-0.74	
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	42
	11			-1.23	41
81	10	37		-1.28	40
80	9		6	-1.34	39
79	8	36		-1.41	37 – 38
78	7	35		-1.48	36
77	6			-1.56	34 – 35
75-76	5	34	5	-1.65	33
73-74	4	32-33		-1.75	32
71-72	3	31		-1.88	31
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	30
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	≤ 29

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 27) included Afrikaans- and English-speaking, coloured and white participants with 5 to 8 years of education.

Table 141. *WISC Coding Normative Conversion Table: for 12- to 13-year-old, male participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 -≥19	> 2.67	>57
133-139	99	73-76	17	2.33	
130-132	98	70-72	16	2.05	57
128-129	97	69		1.88	
126-127	96	67-68		1.75	
124-125	95	66	15	1.65	
123	94			1.56	56
122	93	65		1.48	
121	92	64		1.41	55
120	91		14	1.34	54
119	90	63		1.28	53
	89			1.23	52
118	88	62		1.18	51
117	87			1.13	50
116	86	61		1.08	49
	85			1.04	
115	84	60	13	0.99	
	83			0.95	48
114	82	59		0.92	
113	81			0.88	
	80			0.84	
112	79	58		0.81	47
	78			0.77	
111	77			0.74	46
	76	57		0.71	
110	75		12	0.67	
	74			0.64	45
109	73	56		0.61	
	72			0.58	44
	71			0.55	
108	70			0.52	43
	69	55		0.50	42
107	68			0.47	
	67			0.44	41
106	66	54		0.41	40
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	39
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	38
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	37
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	36
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	35
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	34
83	13			-1.13	
82	12	38		-1.18	33
	11			-1.23	
81	10	37		-1.28	32
80	9		6	-1.34	31
79	8	36		-1.41	
78	7	35		-1.48	30
77	6			-1.56	29
75-76	5	34	5	-1.65	28
73-74	4	32-33		-1.75	27
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	26
61-67	1	24-27	3	-2.33	25
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0-24

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 21) included Afrikaans- and English-speaking, coloured participants with 5 to 8 years of education.

Table 142. *WISC Coding Normative Conversion Table: for 14- to 15-year-old, female participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw
140- ≥145	>99	77- ≥80	18 - ≥19	> 2.67	> 89
133-139	99	73-76	17	2.33	87-89
130-132	98	70-72	16	2.05	86
128-129	97	69		1.88	83-85
126-127	96	67-68		1.75	80- 82
124-125	95	66	15	1.65	77-79
123	94			1.56	
122	93	65		1.48	76
121	92	64		1.41	
120	91		14	1.34	75
119	90	63		1.28	
	89			1.23	
118	88	62		1.18	74
117	87			1.13	
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	73
	83			0.95	
114	82	59		0.92	72
113	81			0.88	
	80			0.84	
112	79	58		0.81	
	78			0.77	71
111	77			0.74	
	76	57		0.71	
110	75		12	0.67	
	74			0.64	70
109	73	56		0.61	
	72			0.58	69
	71			0.55	
108	70			0.52	68
	69	55		0.50	
107	68			0.47	67
	67			0.44	
106	66	54		0.41	66
	65			0.39	
	64			0.36	65
105	63		11	0.33	
	62	53		0.31	64
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	
101	53			0.08	63
	52			0.05	
	51			0.03	
100	50	50	10	0	
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	62
	43			-0.18	
97	42	48		-0.20	61
	41			-0.23	
	40			-0.25	60
96	39			-0.28	
	38	47		-0.31	59
95	37		9	-0.33	
	36			-0.36	58
	35			-0.39	
94	34	46		-0.41	
	33			-0.44	57
93	32			-0.47	
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	56
	24	43		-0.71	
89	23			-0.74	55
	22			-0.77	
88	21	42		-0.81	54
	20			-0.84	
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	53
83	13			-1.13	
82	12	38		-1.18	52
	11			-1.23	
81	10	37		-1.28	51
80	9		6	-1.34	49 – 50
79	8	36		-1.41	46 – 48
78	7	35		-1.48	44 – 45
77	6			-1.56	41 – 43
75-76	5	34	5	-1.65	40
73-74	4	32-33		-1.75	39
71-72	3	31		-1.88	
68-70	2	28-30	4	-2.05	38
61-67	1	24-27	3	-2.33	37
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0 – 36

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 21) included Afrikaans- and English-speaking, coloured and white participants with 7 to 10 years of education.

Table 143. *WISC Coding Normative Conversion Table: for 14- to 15-year-old, female participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	> 75
133-139	99	73-76	17	2.33	75
130-132	98	70-72	16	2.05	74
128-129	97	69		1.88	73
126-127	96	67-68		1.75	72
124-125	95	66	15	1.65	71
123	94			1.56	
122	93	65		1.48	
121	92	64		1.41	
120	91		14	1.34	70
119	90	63		1.28	
	89			1.23	69
118	88	62		1.18	
117	87			1.13	68
116	86	61		1.08	
	85			1.04	
115	84	60	13	0.99	67
	83			0.95	
114	82	59		0.92	66
113	81			0.88	65
	80			0.84	64
112	79	58		0.81	
	78			0.77	63
111	77			0.74	
	76	57		0.71	62
110	75		12	0.67	61
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	60
	69	55		0.50	
107	68			0.47	
	67			0.44	59
106	66	54		0.41	58
	65			0.39	
	64			0.36	
105	63		11	0.33	
	62	53		0.31	
104	61			0.28	57
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	56
	54	51		0.10	
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	
99	47			-0.08	55
	46	49		-0.10	
98	45			-0.13	54
	44			-0.15	
	43			-0.18	53
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	
94	34	46		-0.41	52
	33			-0.44	
93	32			-0.47	
	31	45		-0.50	51
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	50
90	25		8	-0.67	49
	24	43		-0.71	
89	23			-0.74	48
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	47
87	19			-0.88	
86	18	41		-0.92	
	17			-0.95	46
85	16	40	7	-0.99	
	15			-1.04	
84	14	39		-1.08	
83	13			-1.13	
82	12	38		-1.18	
	11			-1.23	
81	10	37		-1.28	
80	9		6	-1.34	45
79	8	36		-1.41	
78	7	35		-1.48	44
77	6			-1.56	43
75-76	5	34	5	-1.65	42
73-74	4	32-33		-1.75	40 – 41
71-72	3	31		-1.88	39
68-70	2	28-30	4	-2.05	
61-67	1	24-27	3	-2.33	38
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0 – 37

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 35) included Afrikaans- and English-speaking, coloured participants with 7 to 10 years of education.

Table 144. *WISC Coding Normative Conversion Table: for 14- to 15-year-old, male participants with advantaged quality of education*

Std	%ile	T	SS	z	Raw	Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	>79	100	50	50	10	0	60
133-139	99	73-76	17	2.33			49			-0.03	
130-132	98	70-72	16	2.05	79		48			-0.05	
128-129	97	69		1.88	78	99	47			-0.08	
126-127	96	67-68		1.75			46	49		-0.10	
124-125	95	66	15	1.65	77	98	45			-0.13	
123	94			1.56			44			-0.15	59
122	93	65		1.48	76		43			-0.18	
121	92	64		1.41		97	42	48		-0.20	
120	91		14	1.34			41			-0.23	
119	90	63		1.28	75		40			-0.25	
	89			1.23		96	39			-0.28	58
118	88	62		1.18	74		38	47		-0.31	
117	87			1.13	73	95	37		9	-0.33	
116	86	61		1.08	72		36			-0.36	
	85			1.04	71		35			-0.39	57
115	84	60	13	0.99	69-70	94	34	46		-0.41	
	83			0.95	68		33			-0.44	56
114	82	59		0.92	67	93	32			-0.47	55
113	81			0.88	65-66		31	45		-0.50	54
	80			0.84		92	30			-0.52	53
112	79	58		0.81			29			-0.55	52
	78			0.77			28			-0.58	51
111	77			0.74		91	27	44		-0.61	50
	76	57		0.71			26			-0.64	
110	75		12	0.67		90	25		8	-0.67	49
	74			0.64			24	43		-0.71	48
109	73	56		0.61	64	89	23			-0.74	47
	72			0.58			22			-0.77	46
	71			0.55		88	21	42		-0.81	45
108	70			0.52	63		20			-0.84	
	69	55		0.50		87	19			-0.88	
107	68			0.47	62	86	18	41		-0.92	
	67			0.44			17			-0.95	
106	66	54		0.41		85	16	40	7	-0.99	
	65			0.39			15			-1.04	
	64			0.36		84	14	39		-1.08	44
105	63		11	0.33		83	13			-1.13	
	62	53		0.31		82	12	38		-1.18	43
104	61			0.28			11			-1.23	
	60			0.25		81	10	37		-1.28	42
	59			0.23		80	9		6	-1.34	
103	58	52		0.20		79	8	36		-1.41	41
	57			0.18	61	78	7	35		-1.48	40
	56			0.15		77	6			-1.56	39
102	55			0.13		75-76	5	34	5	-1.65	37 – 38
	54	51		0.10		73-74	4	32-33		-1.75	35 – 36
101	53			0.08		71-72	3	31		-1.88	33 – 34
	52			0.05		68-70	2	28-30	4	-2.05	32
	51			0.03		61-67	1	24-27	3	-2.33	30 – 31
100	50	50	10	0	60	≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0 – 29

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 16) included Afrikaans- and English-speaking, coloured and white participants with 7 to 10 years of education.

Table 145. *WISC Coding Normative Conversion Table: for 14- to 15-year-old, male participants with disadvantaged quality of education*

Std	%ile	T	SS	z	Raw
140-≥145	>99	77-≥80	18 - ≥19	> 2.67	>78
133-139	99	73-76	17	2.33	78
130-132	98	70-72	16	2.05	75-77
128-129	97	69		1.88	71-74
126-127	96	67-68		1.75	69-70
124-125	95	66	15	1.65	67-68
123	94			1.56	65
122	93	65		1.48	64
121	92	64		1.41	
120	91		14	1.34	
119	90	63		1.28	63
	89			1.23	
118	88	62		1.18	62
117	87			1.13	
116	86	61		1.08	61
	85			1.04	
115	84	60	13	0.99	60
	83			0.95	
114	82	59		0.92	
113	81			0.88	59
	80			0.84	
112	79	58		0.81	58
	78			0.77	
111	77			0.74	57
	76	57		0.71	
110	75		12	0.67	56
	74			0.64	
109	73	56		0.61	
	72			0.58	
	71			0.55	
108	70			0.52	
	69	55		0.50	55
107	68			0.47	
	67			0.44	54
106	66	54		0.41	53
	65			0.39	52
	64			0.36	51
105	63		11	0.33	50
	62	53		0.31	
104	61			0.28	
	60			0.25	
	59			0.23	
103	58	52		0.20	
	57			0.18	
	56			0.15	
102	55			0.13	
	54	51		0.10	49
101	53			0.08	
	52			0.05	
	51			0.03	
100	50	50	10	0	

Std	%ile	T	SS	z	Raw
100	50	50	10	0	
	49			-0.03	
	48			-0.05	48
99	47			-0.08	47
	46	49		-0.10	
98	45			-0.13	
	44			-0.15	
	43			-0.18	
97	42	48		-0.20	
	41			-0.23	
	40			-0.25	
96	39			-0.28	
	38	47		-0.31	46
95	37		9	-0.33	
	36			-0.36	
	35			-0.39	45
94	34	46		-0.41	
	33			-0.44	44
93	32			-0.47	43
	31	45		-0.50	
92	30			-0.52	
	29			-0.55	
	28			-0.58	
91	27	44		-0.61	
	26			-0.64	
90	25		8	-0.67	
	24	43		-0.71	
89	23			-0.74	42
	22			-0.77	
88	21	42		-0.81	
	20			-0.84	41
87	19			-0.88	
86	18	41		-0.92	40
	17			-0.95	39
85	16	40	7	-0.99	38
	15			-1.04	
84	14	39		-1.08	37
83	13			-1.13	
82	12	38		-1.18	36
	11			-1.23	33-35
81	10	37		-1.28	31-32
80	9		6	-1.34	30
79	8	36		-1.41	
78	7	35		-1.48	
77	6			-1.56	
75-76	5	34	5	-1.65	
73-74	4	32-33		-1.75	
71-72	3	31		-1.88	29
68-70	2	28-30	4	-2.05	28
61-67	1	24-27	3	-2.33	27
≤55 - 60	<1	≤20 -23	≤1 - 2	≤-3.00 -2.67	0 – 26

Note. Std = standard/IQ score (M = 100; SD = 15); %ile = percentile; T = T-score (M = 50; SD = 10); SS = scaled score (M = 10; SD = 3); the sample (*n* = 34) included Afrikaans- and English-speaking, coloured participants with 7 to 10 years of education.